July 1945

Surveying and Mapping

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A Message from President Borden

Conference on Mapping Needs
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Municipal Geodetic Control
JOSEPH M. DEARBORN

Surveying and Mapping in Canada
F. H. PETERS

Magnetic Declination with a Transit
PROF. HERMAN J. SHEA

New Mapping Instrument by Corps of Engineers
CAPT. D. J. FAUSTMAN

Qualifications for Surveying
PROF. F. W. PEARCE

Projection Ruling Machine of the Coast Survey
STEPHEN ROSE

The Mackenzie River Mapping Project
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Our New President

FRANK SPAULDING BORDEN was born in Mehoopany, Pennsylvania, September 19, 1888. He received his early education in the public schools of Tunkhannock, Pennsylvania, and at Wyoming Seminary, Kingston, Pennsylvania. In 1911 he was graduated from Lehigh University with a degree in Civil Engineering, and soon after joined the field service of the U. S. Coast and Geodetic Survey. He is commissioned a Hydrographic and Geodetic Engineer with the rank of Commander. During World War I he was assigned to the Coast Artillery Corps and served in France as Battery Commander in the 48th Artillery.

Commander Borden has had a variety of experience both in the field and in the office. His field assignments include responsible charge of triangulation, topographic, hydrographic, and tide and current surveys along the coasts of continental United States, Alaska, and the Philippine Islands. For over ten years he was in command of major surveying ships of the Survey. From 1928 to 1936 he was Chief, Section of Field Work in the Division of Hydrography and Topography, during which period some of the foremost advances in hydrographic technique were developed in the Bureau. Then followed a 4-year tour of sea duty, and in 1940 he returned to Washington as Chief, Division of Charts, in which capacity he has seen the distribution of nautical and aeronautical charts grow from a few hundred thousand a year to over 20 millions.

His favorite class of field work is offshore hydrography and many of the present precise methods of running taut-wire sun-azimuth traverses at sea are due to his development. He was also responsible for the adoption by the Bureau of metal-mounted planetable sheets. He initiated and contributed to the development of the "Field Engineers Bulletin" of the Bureau to serve as an unofficial medium for the exchange of technical information between field parties.

He is a member of the American Society of Civil Engineers, Society of American Military Engineers, American Geophysical Union, U. S. Naval Institute, and the Washington Society of Engineers. He has been an active member of the American Congress on Surveying and Mapping, ever since its inception, and served as Chairman of the Publications Committee prior to his election as President.

Commander Borden is married and has one son and one daughter. His son is a Lieutenant in the Navy and his son-in-law a Captain in the Army Air Forces.

A Message from President Borden

THE HONOR of being elected President of the American Congress on Surveying and Mapping is one which I value highly. There is no other organization in which I would prefer to hold such an office. I realize its responsibility, but I am not unmindful of its opportunity. The objectives of the Congress as set forth in its Constitution are in themselves an inspiration to one whose primary interests are centered in surveying and mapping. I should like to feel that each of us is so familiar and so imbued with the spirit of these objectives that the need for the Congress becomes almost axiomatic.

It is sometimes said that the American Congress on Surveying and Mapping was 50 years late in getting started. Perhaps that is true. If so it merely points up the fact that there is much to be done in the future to make up for the opportunities that were missed in the past. Today the Congress is a going and a growing concern—thanks to the vision of a relatively small group who recognized the need as well as the potentialities of such an organization. They felt that for too long surveying and mapping had been everybody's business and therefore nobody's business, and they had the courage to do something about it. It is a tribute to their foresight and enthusiasm that the organization has been carried forward with a healthy growth on a fundamentally sound basis, even in the midst of several trying war years.

What the Congress has accomplished during the past 2 years and what is indicated for it in the future, is forcefully reviewed in this issue by the retiring President, Mr. George D. Whitmore. It was fortunate for the Congress, and in a sense a measure of the worth of the Congress, that it was able to attract to its leadership a man of Mr. Whitmore's caliber during a time when the future of the Congress virtually hung in the balance. It was his complete devotion to the purposes of the Congress, his wise counsel, together with his professional standing in the surveying and mapping world, that knitted the activities of the Congress together and gave it a prestige of which we may all feel justly proud. It is a source of great personal satisfaction to know that Mr. Whitmore is to remain active in Congress affairs and has agreed to head the Committee on Publications.

In this brief message I should like to address myself to two activities which seem to me to be paramount at this time. The first is that of increasing our membership, and the second is improving our Journal. These activities are in a sense mutually dependent. The larger our membership the better can our publication become; and conversely, the better our publication becomes, the more members will we attract.

While our steady growth in membership is encouraging, there is a

feeling among many that we are not capitalizing sufficiently on our unique status. As the only organization in the United States devoted exclusively to the interests of the surveying and mapping profession we have a potential that should be translated into a membership many times our present size. Too frequently we are told that the only reason a person has not made application for membership is that he did not know of the existence of the Congress. This situation can be remedied if each member will take it upon himself to publicize the Congress and its work to his own immediate circle of professional associates. Every community in this country should have at least one representative in the Congress. Our influence in the surveying and mapping field will be increasingly felt as our membership grows, and it is for this reason that I make this appeal to you to do your share in making our Nation-Wide Membership Drive a success.

And closely associated with the enlargement of our membership is the improvement of our publication SURVEYING AND MAPPING. It should be obvious that the principal means of promoting an increase in membership is through our Journal. Even in its present form it is already filling a long-felt need in the surveying and mapping world. We should take greater advantage of this fact. But while we have traveled far in the right direction much remains yet to be done. The Journal should be enlarged, both in content and format, and should be published at closer intervals.

The postwar period will see a tremendous upsurge in basic mapping programs. That we will emerge a more map-conscious America can be set down as almost a truism. There are already abundant indications of this from many directions. The American Congress on Surveying and Mapping, together with other technical organizations having similar interests, should assume leadership in encouraging and guiding these programs. Through our Journal and through our organizational activities it should be possible to contribute effectively towards these ends.

FRANK S. BORDEN,
President.

* * *

"Of course the first thing to do was to make a grand survey of the country she was going to travel through. It's something very like learning Geography, thought Alice."

—*Alice Through the Looking Glass.*

Remarks of the Retiring President

ON THIS sort of occasion it is customary for the retiring President to review and summarize accomplishments of his administration, or to give reasons for lack of accomplishment. In this instance, speaking for the entire team of officers and committee members, we prefer to be brief in these respects, and to indicate only a few general accomplishments which we hope are apparent to the members anyhow and which would include:

(1) Substantial and solid growth in membership, although far from sensational as to numbers.

(2) Instituting new activities, including (*a*) the creation of an active Property Surveys Division, and (*b*) the sponsoring of regional meetings for State-by-State study of a national mapping program.

(3) Enlarging and improving our publication, SURVEYING AND MAPPING.

(4) Awakening and accelerating interest and enthusiasm among the members—an intangible but, we feel, important accomplishment.

We must not forget that the CONGRESS is, after all, only 4 years old, and that when this administration took over 2 years ago, it was in the midst of a difficult period. We had to organize an entirely new team of officers and committee chairmen, and frankly, for a few months, we were not too encouraged. In view of the general situation at that time, our publicly announced ambitions were modest, and consisted principally of two points: (1) to maintain and solidify the existing membership, as well as to expand it slightly; and (2) to enlarge and improve the publication, SURVEYING AND MAPPING. We believe we can have the satisfaction of feeling that these two modest aims have been accomplished.

Contrary to tradition, we prefer on this occasion to emphasize a few of the unexpressed aims and activities we had privately hoped to accomplish, but which we either did not start, or were not able to complete. These would include:

(1) An intensive membership drive, by direct mail campaign and other means, for which the organizing work has now been completed. It is expected that such a drive will bring in hundreds of private-practice surveyors and city, county, and state employees—these fields of membership having been barely touched so far.

(2) Better and bigger annual meetings, with technical division sessions, exhibits of instruments and maps, with plenty of time for full discussion of all papers, the meetings to run for 2 or 3 days.

(3) Organizing each of the nine regions in the United States on a self-sustaining basis, with regularly scheduled regional meetings, election of regional officers, etc.

(4) Energizing and activating all Technical Divisions, to be at least as active as the Property Surveys Division has been, and all working on definite programs of proper standards, specifications, procedures, etc.

These are only a few of the many activities we should like to have started or completed. All of them, and many others, have been discussed frequently at meetings of the Executive Committee, and at many informal gatherings. They are so obviously worth while that we have no hesitancy in assuming the new President and his fellow officers will immediately initiate or carry forward all of them, as well as many others not mentioned. I feel confident, based on my own gratifying experiences during these 2 years in office, that the new administration will have the active help and co-operation of the other officers and many of the members.

Because of my close association with the headquarters of this CONGRESS during the past 2 years, I cannot escape a conviction that all branches of the Surveying and Mapping profession are entering a new era. The signs are all around us in this respect. This is a firm conviction on my part, and I believe it is just as firm with all of those who have worked in the center of this Organization during this period.

In conclusion, I must say for myself, and I say it sincerely, that I have really enjoyed these 2 years, in spite of the large amount of work required, and have especially enjoyed the necessary close associations with other officers and certain active members. As unusual as it seems, nearly all of our officers and members seem to be high-grade people.

Of course, I would like to thank, publicly and individually, each officer, committeeman, and member who has helped during these past 2 years. Obviously, that is not practical—the list would be too long. There are, however, two members of the officer team who warrant special mention, because the bulk of the work load has been carried by them, and because they do their jobs so well. These are Treasurer and Acting Executive Secretary, Major Richard T. Evans, who certainly deserves special commendation for his capable handling of two time-consuming jobs; and Editor A. L. Shalowitz, efficient Editor and generalissimo of our publication, SURVEYING and MAPPING.

Speaking of the publication, it is my observation that it is universally respected and admired. I personally believe it to be the best publication, devoted entirely to surveying and mapping, in the world today, and, of course, all of us understand that what we have today in our publication, is, after all, only a beginning. Practically all of the credit for this goes to Editor Shalowitz.

We now turn over to our new President, Commander Frank S. Borden, the administration and affairs of the American Congress on Surveying and Mapping, with our congratulations and best wishes for a pleasant and

prosperous administration. As most of us know, he has been one of the active leaders of this CONGRESS during the past few years. He has always found time to attend Executive Committee meetings as adviser and counselor and, of course, has done an excellent job as Chairman of the Publications Committee. We therefore naturally will expect substantial forward gains, because the times seem to be propitious, and because we are assured of enthusiastic and good leadership.

GEORGE D. WHITMORE

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Responsibilities of the Surveyor

THE VOCATION of the Civil Engineer has always been invested with a dignity of its own. But it seems to me that of late years, in paying him the honor which is his just due, we are apt to fix a little too wide a gap between him and his humbler brother, the Surveyor. We give engineering the chief attention in our technical schools, but surveying we are wont to relegate to the Freshman class. Yet the profession of the Surveyor deals with one of the oldest and most fundamental facts of human society—the possession and inheritance of land. Fire, flood and earthquake wipe out the greatest works of the engineer, but the land continueth forever.

Curiously enough the Surveyor is isolated in his calling, and therein lie his responsibility and his temptations. The lawyer comes nearest to understanding the work, yet of the actual details of a survey most lawyers are woefully ignorant. The business man who can judge to a hair the fulfillment of a contract has no eye for the shortened line or the shifted landmark. To the skilled accountant of the bank the traverse sheet is a closed book. Dishonesty in ordinary business life cannot long be hid and errors in accounts quickly come to light, but the false or faulty survey may pass unchallenged through the years, for few but the Surveyor himself are qualified to judge it. I maintain that in the hands of the Surveyor, to an exceptional degree, lie the honor of the generations past and the welfare of the generations to come; in his keeping is the Doomsday Book of his community, and who shall know if he is false to his trust? Therefore I believe that to every Surveyor who values his honor and has a full sense of his duty the fear of error is a perpetual shadow that darkens the sunlight.

Yet it seems to me that to a man of active mind and high ideals the profession is singularly suited; for to the reasonable certainty of a modest income must be added the intellectual satisfaction of problems solved, a sense of knowledge and power increasing with the years, the respect of the community, the consciousness of responsibility met and work well done. It is a profession for men who believe that a man is measured by his work, not by his purse, and to such I commend it.—A. C. Mulford in "Boundaries and Landmarks," 1912.

The Fifth Annual Meeting

THE FIFTH ANNUAL MEETING of the American Congress on Surveying and Mapping was held in Washington, D. C., on June 23, 1945, in the auditorium of the National Archives. Eighty-five persons attended. Because of wartime restrictions, the meeting this year was limited to an evening session.

The Congress was officially opened by President Whitmore, who explained the reason for the type of meeting held this year. After naming Mr. R. F. Wilcoxin to head a Tellers Committee, he called upon Mr. Murray Y. Poling to present to the Congress seven Latin-American guests. They are now in the United States under Fellowships awarded them by the U. S. Coast and Geodetic Survey through the Interdepartmental Committee on Cultural and Scientific Co-operation of the Department of State. The guests attending were as follows:

Señor Antonio Hirsch Marcolina Fragozo and Señor Aleyon da Fonseca Doria, of Brazil; Dr. José Ignacio Ruiz, of Colombia; Ing. Gabriel Ortiz Santos, of Mexico; Teniente Comandante Américo González M., of Paraguay; Teniente Coronel Bernardo Dianderas L. and Capitán Abel Carrera N., of Perú.

President Whitmore officially greeted the guests and extended an invitation for them to attend future meetings of the Congress.

REPORTS

Major Richard T. Evans reported on the general activities of the Congress during the past year and also presented a treasurer's report. Both of these are reprinted in full under "Congress News." Major Evans pointed out the steady growth in our membership and expressed the hope that the rate of increase would be greatly accelerated when the membership drive gets underway.

Mr. S. A. Bauer, Chairman of the Property Surveys Division, reported on the activities of his Division during the past year. He stressed in particular the work of his committee on Technical Standards and showered high praise on its chairman, Mr. William C. Wattles. In his opinion, Mr. Wattles' report on Standards of Practice, "represents the most forward step yet taken in that direction." Mr. Bauer's complete report is reprinted under "Congress News."

Mr. A. L. Shalowitz, the Editor of SURVEYING AND MAPPING, related some of the less obvious things that go into the makeup of our publication. He stated that we should have as much original material as possible in our publication, and to that end he urged the members to prepare articles for the magazine. Mr. Shalowitz' complete remarks will be published in the October issue of SURVEYING AND MAPPING.

Panel Discussion

The feature of the program was a panel presentation on "Co-operation Among the Technical Societies." The participants of this discussion were Mr. O. M. Miller of the American Geographical Society, representing the American Society of Photogrammetry; Mr. R. M. Wilson of the U. S. Geological Survey, representing the Washington Section of the American Society of Civil Engineers; Mr. C. H. Swick of the U. S. Coast and Geodetic Survey, representing the American Geophysical Union; Prof. Frank C. Mirgain of Rutgers University, representing the Society for the Promotion of Engineering Education; and Commander Frank S. Borden of the U. S. Coast and Geodetic Survey, representing the American Congress on Surveying and Mapping. Professor Mirgain was unable to attend and his paper was read by President Whitmore.

Although time did not permit a discussion of the remarks made by the participants in the panel, the opinions expressed emphasized the need for full co-operation of the various technical organizations in order to provide a means whereby the chief interests of all would be considered through the organization of a joint committee or council formed by leaders representing these organizations.

In his remarks as the retiring President of the Congress, Mr. Whitmore expressed his sincere feelings toward the Congress and gave a brief summary of the accomplishments made during his period in office. He thanked the various officers and committee chairmen for the fine co-operation they have given him during his incumbency and expressed the hope for a bright future for the Congress. Mr. Whitmore's full remarks are published elsewhere in this issue.

Mr. R. F. Wilcoxin, the Chairman of the Tellers Committee, advised of the election of Commander Frank S. Borden as President of the Congress for the ensuing year. The affairs of the Congress were then officially turned over to President Borden, who thanked the membership for the honor and solicited their continued co-operation. Commander Borden paid high tribute to Mr. Whitmore for his successful handling of Congress affairs and expressed the thought that with the foundation that has been laid, the future of the Congress looks bright.

The Fifth Annual Meeting concluded with the showing of a War Department film on "Resisting Enemy Interrogation."

MURRAY Y. POLING

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Enroll one of Your Professional Associates as a Member.

Congress Inaugurates Intensive Membership Drive

THE first Membership Drive of the American Congress on Surveying and Mapping will get underway September 1, 1945.

The recognized importance of this organization to future surveying and mapping activities and the related fields justifies the full co-operation of its members. It is through the co-ordinated efforts of those who are leaders, as well as those who are interested in these fields, that this organization can be expanded to hemispheric influence and improvement of the profession—thereby contributing to the future welfare of those who have made this profession their life work.

The need for expanding our publication, SURVEYING AND MAPPING, is emphasized by President Borden and this need is recognized by other leading members of the Congress. This can be accomplished by enlarging our membership, as it is through the membership fees that it is possible to publish this already outstanding publication.

Our goal of 500 new members within the next few months is a modest one when one considers the number of individuals actively engaged or interested in surveying and mapping and the related fields.

A new prospectus of the Congress has been prepared. This, together with special invitation cards and membership blanks, will be forwarded to you shortly. Additional copies may be obtained through the Vice President of your Region or direct from the Membership Committee in Washington, D. C.

The Membership Committee urges all members to participate actively in this nation-wide enrollment. *Every member should enroll at least one new member.* Contact your professional associates. You will probably be surprised to learn how easily a member can be enrolled once he understands the objectives and possibilities of our organization.

An application card is enclosed for immediate enrollment of a new member.

THE NATIONAL MEMBERSHIP COMMITTEE

Walter S. Dix
Ralph M. Berry
Murray Y. Poling, *Chairman.*

Regional Conference on Topographic Mapping Needs

By MARSHALL S. WRIGHT*

EDITOR'S NOTE.—One of the fundamental purposes of the American Congress on Surveying and Mapping is to study, promote, and sustain a national program of basic topographic mapping. Believing that the Congress could serve as an effective medium for a discussion of the broad needs of the various agencies concerned, Mr. Marshall S. Wright, Vice President of Region 2, convoked a conference of representatives from the states comprising his Region. Mr. Wright presided over the sessions and the following is a report of the Conference.

A GROUP of representatives from the States of Delaware, Maryland, New Jersey, Pennsylvania, Virginia, and West Virginia, comprising Region 2 of the American Congress on Surveying and Mapping, met in Washington on June 21, 1945, to participate with representatives of the Federal Government in a Discussion of Topographic Mapping Needs.

The meeting, which comprised a one-day session, was restricted in attendance to comply with the Office of Defense Transportation requirements. It was arranged primarily to give the State representatives an opportunity to discuss their common problems, and to endeavor to develop an integrated mapping program with representatives of the federal map-making organizations. It appeared desirable to discuss the map needs of the various state organizations and public utility corporations, and to co-ordinate these needs with those of the Federal Government.

Mr. R. H. Randall of the Bureau of the Budget presented the interests and desires of the Federal Government in the production of maps, and expressed the hope that a well co-ordinated program could be formulated. He outlined the objectives of the Bureau of the Budget and indicated the maner in which the various federal map-using agencies keep his office informed of their respective needs for maps.

Mr. Chalfant and Mr. Pitkin of the Pennsylvania State Planning Board outlined the method that had been developed in Pennsylvania to determine the priority order and scale of topographic quadrangle sheets needed to serve the requirements of the various State departments. The State Planning Board had devised a method of deriving a "priority point value" for each 15-minute quadrangle. By a system of "weighting," the needs of each department was determined in relation to other departments, and then by applying a simple formula the priority order of each quadrangle was arrived at. The entire method is clearly outlined in a

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report issued by the Board in February 1945, entitled "Topographic Mapping Needs." Pertinent extracts from this report are appended hereto.

Dr. W. E. Wrather, Director of the U. S. Geological Survey, presented a paper on "The Topographic Mapping Situation in the United States" and pointed out the extent to which the country had been mapped to date. He stressed the need for some co-ordinated effort toward the development of a continuous National Mapping Program based upon the indicated needs of state, public utility, and federal agencies.

The tremendous part played by the U. S. Coast and Geodetic Survey in establishing first- and second-order horizontal and vertical control for the use of all agencies in their mapping projects was outlined by Admiral L. O. Colbert, Director of the Survey.

State Representatives

The representatives from the States comprising Region 2 were:

New Jersey: Mr. Meredith E. Johnson, State Geologist, Department of Conservation and Development.

Pennsylvania: Mr. Floyd Chalfant, Secretary, Mr. Francis A. Pitkin, Executive Director, and Mr. James A. Patterson, of the State Planning Board, Department of Commerce.

Maryland: Dr. Joseph T. Singewald, Jr., Director, Department of Geology, Mines, and Water Resources; Mr. William F. Childs, Jr., Director, Department of Public Works; Mr. I. Alvin Pasarew, Director, Maryland State Planning Commission; Mr. Carroll F. Merriam of the Pennsylvania Water and Power Company; Mr. B. E. Beavin of the J. E. Greiner Company, Consulting Engineers; Mr. James C. Hunt of the City of Baltimore; Mr. J. W. Pearce of the Consolidated Gas, Electric Light, and Power Company of Baltimore; Captain R. M. Ridgely of the Department of Maryland State Police.

Virginia: Mr. Raymond V. Long, Director, State Planning Board; Mr. A. H. Bell and Mr. David Huddle of the Department of Highways.

West Virginia: Mr. M. Earl Campbell, State Planning Engineer and Mr. C. A. Rothrock of the State Roads Commission.

* * * *

PENNSYLVANIA STATE PLANNING BOARD REPORT

(Extracts only)

Inception of Study

To initiate the study, the State Planning Board arranged a meeting of representatives of the various State departments, public utility companies operating in the State, and representatives of federal agencies.

The Board's objective was to prepare a statement, in both graphic and list

form, of the areas in which topographic mapping was needed, expressing such needs in four orders of priority. The statement was also to include recommendations as to the publication scale of the maps required.

It was pointed out at the first meeting that mapping needs were not necessarily to be limited to funds now available from State or federal sources, but should be determined on the basis of the engineering and planning activities of the respective agencies, without consideration of the source or amount of funds required.

Procedure

Maps of the State, on a scale of 1: 1,000,000, (published by the United States Geological Survey) showing the 15-minute quadrangle layout, were furnished by the Board to each State department and public utility company participating in the study. On these maps, the quadrangles which were considered adequately mapped were shown. Each agency was requested to indicate its interest in having inadequately mapped areas—or unmapped ones—mapped, and to designate the order of priority desired, for each quadrangle. In order to show the desired priorities in each quadrangle, the number "1" was to be placed within the boundaries of all those quadrangles considered to be first priority, number "2" for second priority, and so on up to number "4" for fourth. Also, within each of the quadrangles desired to be mapped or remapped, the scales were indicated as follows: a vertical line for a scale of 1 inch = 1 mile (approximately), a horizontal line for a scale of 1 inch = ½ mile (approximately), and a diagonal line for a scale larger than 1 inch = ½ mile.

In general, first priority was understood to indicate an area in which the department or company desired to have published map copies available within (1) or (2) years; second priority, (2) to (3) years; third, (3) to (4) years; and fourth, priority within (4) or more years.

After these maps were completed by the State departments and the public utility companies, they were returned to the State Planning Board. The Board then proceeded to prepare two composite sheets or maps, one showing the requirements of the State departments and the other the public utility companies.

The composite map prepared from the advices of the State departments included the mapping needs and scales from five agencies as follows:

State Game Commission
Department of Health
Department of Forests and Waters
Department of Highways
Department of Internal Affairs (Bureau of Topographic and Geologic Survey)

These five State agencies are probably those which are most concerned with the use of topographic maps. Since the activities of these agencies appear to vary widely, it was believed advisable to weight them according to their relative interests.

In order to place the priorities on a mathematical basis which would provide a range for selection of quadrangles within a priority, the Board assigned values

for each priority, and a base weight for each department. These priority values, or points, multiplied by the base weight assigned each department give what is termed "priority point values."

To obtain the priority point values for a quadrangle, the point values representing the priority specified, by each department, were totaled.

A similar composite map of the topographic needs of the public utility companies was then prepared. In selecting the public utility companies to be included in the study of Topographic Mapping Needs, the operating territories of each company were carefully studied. Those companies whose operations were confined to a small area embracing only a few topographic quadrangles were not considered.

A selection of the telephone companies was made whose territories would cover all or parts of most of the quadrangles of the State but with a minimum of overlapping with respect to the telephone territories. This same procedure was used in connection with the railroads and the electric power companies. The two largest natural gas companies were included in the study, although their combined territories covered only a portion of the State.

The priority points established for the utility companies were inversely proportional to the figures designating the priorities, the same as used for the State departments, or 4—3—2—1 for the respective priorities. It was determined that the requests of the public utility companies were highly important, although many of them were concerned only with specific local areas rather than a statewide coverage. As most of these companies were interested in comparatively small areas, the amount of overlap in the priority requests was limited, and had the effect of reducing the total priority points for the quadrangles in these localities. Because of this condition, it was decided to place these local requests on a comparable basis with the State department having the highest base weight.

The State Planning Board feels that this study should be of considerable value to the federal agencies concerned with mapping, and that the information should be given appropriate weight in the selection of the areas to be mapped.

The Board appreciates that much depends upon the amount of funds made available for mapping from year to year. The study made in Pennsylvania, however, should afford a means of selecting the areas to be mapped irrespective of the amounts appropriated for mapping purposes.

* * *

Courses in Utilization of Aerial Mapping

IN ANTICIPATION of the full utilization of engineering data available to their engineering departments through the use of aerial photographs, engineers from the states of Illinois, Kentucky, Michigan, Wisconsin, the Province of Ontario, and Giffels and Vallet, consulting engineers of Detroit, have just completed an extensive 1-week course in aerial photographic interpretation and map compilation conducted by the Abrams Aerial Survey Corporation at Lansing, Michigan.

The course was composed of subject material vital to highway and airport

planning and design. The advantages to be had by co-ordinated planning of all agencies concerned in regard to flight altitude and scale were fully discussed. By means of the Abrams Contour Finder, center line profiles were run out on the photographs themselves, the contour of the water elevation drawn, and the flooded area behind a dam was computed. Spot checking elevations throughout an area and actual contouring problems were thoroughly studied in actual laboratory problems. The application of single low level strip flights to reconnaissance work, and the assembly of strip mosaics by the straight line method were explained by practical demonstrations.

After the extensive training course, it was the opinion of the entire class that low altitude photography and subsequent map compilation could eliminate a large amount of preliminary field work.

The Abrams Aerial Survey Corporation has been active in conducting such schools throughout the United States. Others of a more intensified nature are already being planned. All equipment used in the instruction is loaned through the co-operation of the Abrams Instrument Corporation.

J. E. MEYER

California Aerial Mapping Project Recommended

EDITOR'S NOTE.—The report prepared by the Reconstruction and Re-employment Commission of California represents a forward step in advancing the basic mapping program of the country. More complete notice of this report will be taken in a later issue of SURVEYING AND MAPPING.

A PROJECT for complete aerial mapping of California during the next 10 years as a co-operative arrangement between state and federal agencies on a 50–50 basis is recommended in a new report by the State Aerial Mapping Project Committee of the Reconstruction and Re-employment Commission. Pointing out that two-thirds of the State is unmapped or inadequately mapped, the report states that aerial mapping is essential since it is the only way to obtain accurate topographic maps and since it greatly shortens the time necessary to complete the maps.

Funds for the proposed project would be used predominantly in employment providing a permanent job for returning veterans with engineering training. "In addition to being useful to all citizens of the State, adequate topographic maps would invite outside capital to make investments in California," the report states. "These maps are essential to development of California's natural resources."

The proposal calls for the State putting up $3,000,000 to be matched with federal funds. A 10-year program would be arranged, with the U. S. Geological Survey doing the mapping and a permanent advisory committee, composed of members of map-using agencies, advising on the yearly programs.—*American Aviation,* May 1, 1945.

Magnetic Declination with an Engineer's Transit

By PROF. HERMAN J. SHEA*

OCCASIONALLY, it is the duty of a land surveyor to determine an approximate value of the declination of the magnetic needle. The usual method of resolving this simple problem is to direct the line of sight of a transit along some line for which the true bearing is known, read the corresponding magnetic bearing, and calculate the magnetic declination from the difference of the bearings. Since it is common practice by surveyors to read magnetic bearings to the nearest one-quarter of a degree, the value of the declination obtained by this process is certainly no better.

In the recent experience of the author, a magnetic survey was required in the vicinity of an aircraft compass turntable. Pressed for time and having no immmediate access to the specialized instruments of terrestrial magnetism, it was necessary to make use of an engineer's transit and to devise a method which would lead to a reasonably precise determination of magnetic declination.

The first step is a careful testing of the compass needle on the transit to be used. The compass needle should be at least four inches in length and preferably of edge-bar construction. With a needle of this type, it is possible to minimize the effect of parallax between the needle and the compass box. If the compass box has a variation or declination adjustjustment, this should be carefully returned to a zero position. The needle should be further tested to insure that it is properly balanced, that it is not bent, and that is swings freely on its pivot. Of course, the needle should be properly magnetized so that it will damp to a steady position in a reasonable length of time.

It was decided that the maximum precision would be obtained by reading a clockwise angle from a mark of known true bearing to the magnetic meridian. In other words, the instrument was set on the mark with the horizontal circle reading zero, then the clockwise angle was noted from this mark to the magnetic meridian as determined by setting the magnetic needle to zero of the compass box.

A program of observations was devised to counterbalance the errors caused by any bending in the needle and by any eccentricity of the pivot. By setting both ends of the needle to their corresponding divisions on the compass box, the effect of a bent needle was eliminated. Then the

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ends of the needle were set to the opposite divisions of the compass box which served to counteract the effect of an eccentric pivot. The sequence and arrangement of this program is illustrated in Figure 1. In addition, two circle readings were read for each condition of setting to increase precision and to insure against blunders.

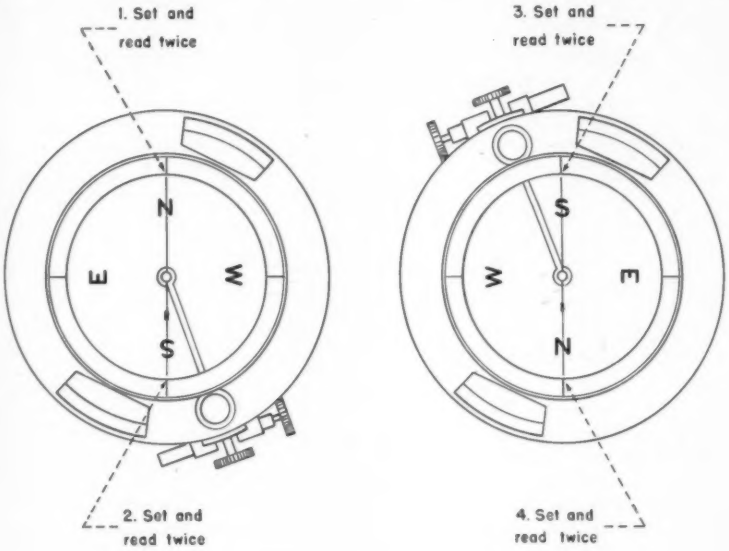

FIGURE 1.—Sequence and program of observations.

Every precaution was taken by the observer to remove from his person materials which might have an influence on the needle. Care must be taken not to overlook any possibility. Often rims of eye and magnifying glasses are constructed of ferro-magnetic materials. Of course, all surveying equipment should be removed to a safe distance.

It was found, after a little practice, that the setting of the magnetic needle to the cardinal point on the compass box could be realized in a fairly short time. By moving the instrument in azimuth about a degree or two between observations, a certainty of setting could be obtained.

SAMPLE SET OF OBSERVATIONS

The following table shows a sample set of observations taken at one

setup. Note that the time was read at the half-way point as this was needed in the computations to compensate for the effect of diurnal variation.

STATION: *C + 62* DATE: *May 14, 1945*
OBSERVER: *A. T. Gifford* INSTRUMENT: *Berger No. 2820*

Needle	*Box Division*	*Horizontal Circle*	*Remarks*
B. S. on Sta. C		0° 00′	True Azimuth* 219° 08′
N	N	125 20	
N	N	125 22	
S	S	125 19	
S	S	125 19	
N	S	305 22	3:10 P. M., Zone + 4h
N	S	305 22	
S	N	305 17	
S	N	305 18	
Check on Sta. C		0 00	
Average		125 20	

* Clockwise from North.

CORRECTION FOR DIURNAL VARIATION

The relataionship between the true azimuth of the line to *C*, the angle from *C* to the magnetic meridian, and the resulting declination of the magnetic meridian is shown in Figure 2. The value of the magnetic declination shown in this figure does not represent an average value because of the effect of diurnal variation. If continuous observations of the magnetic declinations were taken during a day free from magnetic storm, a periodic swing to the compass needle would be found. This diurnal variation depends on the time of the day, the time of the year, and the position of the station. When compared with local mean time, the effect of diurnal variation is to cause the north end of the needle to swing toward the east in the hours before 11 A.M., reaching a maximum at about 8 to 9 A.M. An average value is assumed somewhere between 10 and 11 A.M., local mean time; then the swing is toward the west, reaching a maximum westerly value at about 1 P.M. For more detailed information, the reader is referred to *Magnetic Declination in the United States, 1935*, Serial 592 of the U. S. Coast and Geodetic Survey, pages 27 and 28.

The local mean time of the sample observation is 2:35 P.M., and from the above publication a value − 5′ is obtained for the diurnal variation (north end of the needle too far to the west). Applying this cor-

rection the final value of the magnetic declination at this station is 15° 27′ West.

With reference to the probable precision of this method of observing magnetic declination, it was found that the final values for the magnetic

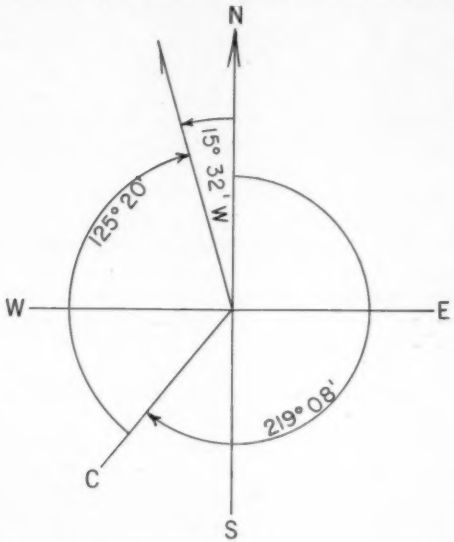

FIGURE 2.—True azimuth, observed angle, and resulting declination.

declination at three stations about 100 feet apart in a region free from magnetic influence had a spread of three minutes. Thus it is felt that quite accurate determination of the magnetic declination may be observed in this manner.

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Aerial Photography at War

FAIRCHILD Camera & Instrument Corp., New York, has issued an illustrated booklet entitled, "Focusing on Victory—The Story of Aerial Photography at War." It contains a series of striking aerial photographs in addition to descriptions of Fairchild aerial cameras and possible uses for them in time of peace.—*American Aviation*, March 1, 1945.

Municipal Geodetic Control for other than Topographic Mapping*

By JOSEPH M. DEARBORN†

CONSIDERABLE emphasis has been placed, in recent years, on the value of control surveys for topographic mapping purposes. Whether executed by ground survey methods or by aerial photogrammetry, it is an established fact that geodetic control is absolutely necessary to secure any reasonable degree of accuracy for a completed topographic map. It is, neither necessary nor is it the purpose of this paper, to discuss or enlarge further on this one of many values of control surveys. However, it does seem important and necessary to emphasize, from the municipal point of view, the great value of horizontal and vertical control for other purposes.

All municipal engineering departments are required by law to provide information relative to the boundaries of public and private property, the location and established grades of its many streets, sewers, curbs, and sidewalks, and the elevation, above a common datum, of any point within reasonable distance of an intended project. Most cities provide this information in two forms; (1) by maps and related card records in the office, and (2) by monumented or otherwise marked points on the ground. There can be no question as to the necessity of providing the most useful, accurate, and reliable information obtainable. There is absolutely no excuse to do otherwise, and any general policy of disseminating data on a "that's good enough" basis will lead unquestionably to serious trouble in the long run.

A great percentage of our American cities have developed without benefit of long-range planning, and no particular emphasis has been placed on their over-all survey needs. Both horizontal and vertical surveys have been made, as necessary, to perform the function for which they were intended. It seems to be more or less standard policy not to make this valuable information a part of a well-integrated whole, but to maintain it as one of thousands of similar surveys. In a period of years, the net result has been a collected mass of unrelated information, much of which is either lost or, if not carefully indexed, forgotten. This condition, combined with the fact that many cities have not progressed with and adopted the more modern methods of this advanced technical era, has led to a lower degree of accuracy in municipal survey work than should be the case.

* Presented at Annual Meeting, Washington, D. C., June 3, 1944.

† Director, Bridgeport Geodetic Survey, Bridgeport, Conn.

Generally, the need for a revamping of a city's over-all survey pattern becomes a matter of serious concern, when it becomes necessary to undertake a project covering an extensive area, such as a trunk sewer or through highway, a block or section map survey, an assessment area study, or by the introduction of a city-wide long-range planning program, all of which require related, accurate, survey and map information to insure their success. If the engineers, laymen, and disbursing authorities in our American cities were sufficiently informed as to the value and permanency of the precise control survey as a solution of their problem, there is no question but what great advancements would be made in municipal survey procedure and accuracy.

The City Geodetic Control Survey

Many years of experimentation, thought, and very careful study have gone into the preparation for what we now call the "City Survey" or the "City Geodetic Control Survey." The procedures and specifications as have been prepared are based solely upon the long-felt need of all cities for a self-perpetuating, reliable, and accurate, inter-related survey system. The entire program is designed to provide a co-ordination of all horizontal and vertical information. This procedure, combined with the fact that the survey is of first-order accuracy, insures for all time against inaccuracy and confusion. The cost of such a survey, at first glance, appears large, yet actually over a period of time it is unusually small, because it abolishes many costly and needless surveys and resurveys during a city's growth. As it is of permanent value, it may be considered as a capital expense and if necessary should be financed in whole or in part by bond issue. The Committee of the Surveying and Mapping Division on City Surveys of the American Society of Civil Engineers published on January 15, 1934, its Manual No. 10, Technical Procedure for City Surveys. This is now considered by the profession as the answer to these many municipal survey problems. It certainly has filled a long-felt need and, although it should be enlarged and re-edited in the light of present-day problems and procedures, it has been for a decade more than satisfactory as a definition of necessary specification and procedure.

Briefly, it provides the following as a basis for a permanent, accurate, municipal survey system: A first-order triangulation network, referred to the North American datum of 1927 and to local rectangular coordinates, with a resultant probable error in length of 1 part in 100,000 and a probable error of any direction no greater than 0.75″; a first-order traverse network, supplementing the triangulation and co-ordinated with it, with a resultant closing average error of 1 part in 35,000 and with a maximum allowable error of 1 part in 20,000; a first-order leveling,

paralleling the traverse, referred to a Mean Sea Level datum as established by the federal level system, with a resultant difference between backward and forward runnings of any section no greater than 0.017 $\sqrt{M}$, where M equals the length of the section in miles.

Thus, upon the completion of the first-order horizontal and vertical control, there is readily available for all to use a permanent, co-ordinated system of unlimited utility. To it, may be tied in and adjusted all second-order work, such as block traverses, private property surveys, river and harbor surveys, and public utility surveys; in fact every type of municipal survey that may be undertaken. Eventually, as individual surveys, past and present, are co-ordinated with the primary control, a city may reach that ideal point where all of its survey information is inter-related in such a manner as to be forever useful, replaceable if destroyed, and capable of careful, efficient indexing and filing for future use. In addition, the control provides a means of checking all additional surveys, avoiding costly and unnecessary re-runs and localizing error. It is now plainly apparent, I believe, that geodetic control surveys have many uses other than for the control of topographic mapping.

The Bridgeport Geodetic Survey

Whatever I may have said up to this point, has been entirely general and has referred to no particular municipality, but rather has been more or less of a summation of conditions found in many cities throughout the country. To illustrate very briefly what can be done in an average city, I should like to tell you something of what we have been able to accomplish and expect to accomplish in the future in the City of Bridgeport. The specifications and procedures used were those in Manual No. 10, supplemented by the publications of the U. S. Coast and Geodetic Survey.

TRIANGULATION

The triangulation scheme was set up by a thorough field reconnaissance, which resulted in a network of 3 base lines and 28 stations controlling an area of 25 square miles. The governing factors for the acceptability of the final chosen net were strength of figure, distribution for control purposes, facilitation of construction and location and suitability of base lines. The station preparation consisted of monumenting and marking the stations with concrete monuments and bronze discs or with concrete roof pimples and discs. It also included the erection of 27 tripods and platforms and one 77-foot Bilby steel tower.

The observing program was carried on at night, using a 10″ illuminated theodolite. The base lines were also measured at night using 50-meter steel tapes, standardized prior to and after use by the National Bureau of Standards. The tape contact method was employed through-

out, utilizing portable taping stools, center support, stretching apparatus, spring balances, and thermometers. All stations were carefully referenced and described, and all roof positions were transferred to the ground by means of transfer triangles.

The usual office computations were made. Such observations as did not meet specifications were sent into the field for re-observation, after which the conditions for adjustment were set up. The adjustment was done by the method of Least Squares and involved the solution of 74 condition equations, which included 49 angle equations, 23 side equations, and 2 length equations. The net result was the corrections to 154 directions which met all specifications and resulted in as near perfect geometrical figures as can be obtained. Utilizing these corrected directions all triangle lengths were recomputed, and with a federal first-order triangulation station as an origin, geographic positions, azimuths, and local Statewide Plane Coordinates were obtained.

TRAVERSE

The traverse was set up by a field and office reconnaissance with a lineal coverage of 90 miles and an even distribution of lines and stations, which resulted in a concentration of 5 linear miles to the square mile. The entire traverse network consisted of 601 stations, 230 of which are permanently monumented, 103 are semi-permanent brass plugs, and 268 are steel pins classified as temporary. A pair of tape standardization monuments were set up utilizing special tapes certified by the National Bureau of Standards, and all traverse tapes were standardized prior to use, and after a maximum of one week's use in the field thereafter.

Angles were measured with a 10″ repeating theodolite and observations were made on $\frac{5}{8}$-inch steel rods, painted alternately red and white, held in a special tripod and collimated over the station by torpedo levels. Taping was accomplished by the tape contact method using taping stools, thermometers, stretcher apparatus, and 100-foot standardized steel tapes.

The office computations included the testing of all field work by the reduction of all taped lengths, and the closing and adjusting of all horizons from the field angles. Such observations as did not meet preliminary specifications were sent into the field for re-observation. The traverse was adjusted by the method of simultaneous weighted mean junction points and involved the adjustment of azimuth at 680 lines and of coordinates at 601 stations. In the computation of traverse coordinates referred to triangulation, local Statewide Plane Coordinates were used.

LEVELS

The level network was set up primarily to provide first-order elevations at all monumented traverse stations, and at such other strategic

points as was felt necessary, and has a lineal coverage of 60 miles or 4 miles to the square mile of controlled area. The entire network consists of 205 bench marks, of which 7 are recovered U. S. Coast and Geodetic Survey marks, 190 are first-order traverse monuments, and 8 are junction point bench marks necessary for adjustment.

The field work was carried out under the specifications set forth in U. S. Coast and Geodetic Survey Special Publication No. 140, Manual of First-Order Leveling, and the instrument used was a precise level of the U. S. Geological Survey type. Precise invar level rods were used, and leveling pins provided suitable turning points. Field abstracts were prepared and re-runs were called for when the work did not meet specifications for allowable divergence between backward and forward runnings of a section.

The computation and adjustment was done in the following manner: A Least Squares adjustment was made of 7 major loops, which included the solution of 9 condition equations to correct 14 elevations, after which the bench marks within the major loops were adjusted by the method of simultaneous weighted mean junction points. All final elevations were adjusted and referred to the federal level system.

FINAL RESULTS

All resulting data from the triangulation, traverse, and levels were compiled and final maps drawn showing this information, to complete a permanent report for future use and recovery. The final specifications attained were as follows:

Triangulation

Average discrepancy in length between base lines	1 part in 3,377,889
Average correction to a direction	0.54″
Probable error of any observed direction	0.64″

Traverse

Average position closure after adjustment of azimuth error	1: 51,468
Maximum position closure after adjustment of azimuth error	1: 20,024
Average correction per angle	1.18″

Levels

Average linear coverage per major loop	5.42 miles
Average loop closure	0.024 foot
Average allowable loop closure	0.039 foot

This is, in effect, what the City of Bridgeport possesses today, as a basis for an up-to-date survey system. It has been of tremendous value and utility since the war, particularly in the line of necessary public works and large sub-divisions. Tentative postwar plans have been made to supplement the work already accomplished when materials and labor are again available. In the meanwhile, what has been accomplished is

proving to be more valuable every day. To the Works Projects Administration, particularly to its federal officers, for their wise counsel and assistance must go due credit for making the Bridgeport Geodetic Survey possible. The city provided technical direction and certain key personnel during the operation of the job but the bulk of the labor was provided by federal assistance. To the men who worked on the job and to many, many others, who are now either in the Armed Forces or in war industries, we owe a great debt. For them and for the future of the City of Bridgeport we intend to make our postwar survey plans one of several opportunities for reemployment on worthwhile public works.

Co-operation Between Federal Survey Agency and Cities

In conclusion, I should like to say that in my considered opinion the field and scope of urban control surveys is beyond even the imagination of those who are in daily contact with it. There is so much necessary work to be done that the task before us seems even greater than all of the splendid work already accomplished by the federal survey agencies thus far. For that reason, I cannot resist this opportunity to suggest a much closer co-operation between the federal agency entrusted with the task of providing the starting information for such surveys and the various cities which will in the future institute such work. It is imperative that there be a fuller understanding of each other's problems, and that these be given full consideration prior to the execution of such surveys. In the past, there have been many discussions between the federal survey agencies and certain cities relative to various technical features of the work. It would be extremely wise to have a full discussion of these problems, with the thought in mind of adopting a standard program for the future. Most cities' needs are peculiar to themselves and must be met if we are to have any success at all in this postwar plan for urban surveys. If such a program of co-operation is instituted, with the city's as well as the federal agency's needs given full and fair consideration, there is no question but what all of our great urban areas will do their full share in fostering and advancing the principles of control surveys.

* * *

"I have wished, particularly since I entered public life, that there was some moral process parallel to the process of triangulation so that the whereabouts, intellectually and spiritually, of some persons could be discovered with more particularity."

—Woodrow Wilson.

Surveying and Mapping in Canada*

By F. H. PETERS†

MIGHT I in commencement express my great pleasure at being here with you today on two grounds: First, I am glad to have the opportunity to take part in the very interesting program which your Committee has arranged, and secondly, my pleasure at being able to greet so many old friends. This is the fourth meeting of the CONGRESS; I was fortunate in being present at the first meeting and have attended all but one of the subsequent meetings. Along with Engenheiro Leite de Castro of Brazil and Lieut. Col. FitzGerald of the U. S. Army Air Forces, I am taking part in a joint statement regarding surveying and mapping activities in the Americas.[1] This is a large subject to cover in the short time allotted, but I have arranged my remarks under three general headings, in accordance with what I have understood would meet, at least in a general way, the ideas of your Committee.

THE CONSULTATIONS ON CARTOGRAPHY

As regards the activities resulting from the First Consultation on Cartography in October 1943, it seems desirable first to draw attention to the fact, which many of you of course know, that Canada is not a member of the Pan American Union and consequently the Canadians who attended the First Consultation could not be officially accredited delegates. This is a situation which may be changed, but in the meantime I would assure you that Canada is most interested in all the scientific and technical problems which are being dealt with by the Consultation.

The First Consultation gave expression to many new ideas and different opinions; these are all being studied by us because it is our desire not only to keep abreast of the times in new scientific and technical developments, but also to keep ourselves prepared for further collaboration. It is a great pleasure to know that other consultations are being planned.

POSTWAR MAPPING IN CANADA

Now to deal shortly, and in general, with the Canadian plans for postwar work. The basic idea is for the postwar period to provide opportunity for everyone to have useful occupation, and this includes plans for the employment of technical men.

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* Presented at Annual Meeting, Washington, D. C., June 3, 1944.

† Surveyor General and Chief, Hydrographic Service, Canada.

[1] See SURVEYING AND MAPPING, January 1945.

The plan is comprehensive and one main objective to be achieved by preliminary consideration and study is that all work which may be undertaken shall be useful work. To this end all prospects, which might possibly be undertaken, are being combed over to determine those which would be most useful and practical. These are being catalogued and listed both geographically and as to the main type of labor which would be involved. With such a catalogue available it should be possible, as the general work program is undertaken, for some agency to direct activities along the proper channels and provide occupation either in geographic districts, where there may be some unemployment, or to select certain undertakings which would employ a certain type of labor to whom it is desired to give some assistance.

For young men who were training for a technical or scientific occupation and whose education has been stopped or interrupted, certain plans are under consideration for giving assistance so that their education can be completed and they will be in a position to earn their own living in their chosen occupation. Without speaking too definitely, these plans for assistance will extend over a period of about two years.

We might now consider the Canadian plans for the postwar period more particularly with reference to surveying and mapping, because these are the things of most interest to this CONGRESS. If the nations of the world were ranked according to the opportunities which exist for further work along this line, Canada would rank very high because her domain is tremendous in extent and there are still large areas which are not adequately mapped, and where no work at all has as yet been done in connection with legal surveys which are necessary as a basis for providing sound title to grants of land and to secure tenure thereof.

Perhaps the most interesting area at the present time is the territory which lies north of the 60th degree of latitude and borders on the areas to the south which have already been organized into provincial areas; these great northern areas comprise the Northwest Territories and Yukon. There are a good many reasons why these northern areas are gathering interest. As you are all aware, there is at the present time a good deal of interest in world air routes and many of these traverse the northerly portions of Canada. The Alaska Highway, which has been constructed from a point north of Edmonton in Alberta through a portion of British Columbia as far as Whitehorse in the Yukon and from there northwesterly into Alaska, has naturally attracted a good deal of attention to these areas through which previously no overland route existed. And then, to quote one more item, there is the great Mackenzie River running from Great Slave Lake down to the Arctic Ocean and in which valley considerable oil fields are in the course of development near Norman Wells, in approximate latitude 65°.

In these areas the attack on the mapping problem must be by air because there are practically no roads running through the country. Already plans have been laid for procuring aerial photographs covering great areas in these territories. In districts such as this, where no surveys have been executed on the ground, there is considerable difficulty in procuring suitable control. With great areas to cover in a short time, time does not permit the extending of geodetic triangulation, and astronomic control has to be resorted to. The general plan is that suitable, though not close, control is procured by observers who are provided with the lightest instrumental equipment capable of obtaining the necessary precision, and they are transported from station to station by aircraft.

I would like to stop here for a moment and make reference to the tri-metrogon photography which has already been done by the U. S. Army Air Forces in certain districts in northern Canada. This work was commenced some time ago to meet the needs of Western Hemisphere defense, and much of it was undertaken, particularly the first season, when there were many difficulties to be met and overcome. While it is not permissible to say very much about it at the present time, the job was one in which the U. S. Army Air Forces can properly take a great deal of pride.

Getting back to the line of our story again, legal surveys for administration purposes are also important, and as a preliminary measure this year it is proposed to make a commencement towards extension of the Dominion Lands Surveys System into the north country by working down the valley of the Mackenzie River with a series of meridian and base lines.

Speaking now more generally of the whole of Canada, the hydrographic work of charting our navigable waters is still reduced due to the lack of survey ships which were taken over by the Navy at the commencement of the war. The work is being carried on, however, on the Pacific coast and on the eastern seaboard. Such work is being continued as is possible on the inshore waters where the smaller hydrographic survey craft can be operated.

The topographic maps at the larger scales are not being overlooked. Surveys for them are being carried on to such extent as is possible under present conditions, and largely in areas of geologic interest, looking to future development in mining both the precious and base metals.

Canada and the American Congress on Surveying and Mapping

Before closing we would like to say a few words about the American Congress on Surveying and Mapping itself and its membership in Can-

ada. As you all realize, these are very difficult times to try to get new members into an organization of this kind, or indeed any organization. However, through the help of your Membership Committee, it has been possible to do a certain amount of work, and this has in the main been directed towards interesting the various associations of land surveyors which exist in nearly all the provinces of Canada. There has been no large-scale enrollment of members, but we think that a good deal of useful work has been done in the way of sowing seeds that will come into bearing in the future. Making just a quick reference, we might say that at Ottawa there are a few members and a very considerable interest is being displayed. In the province of Quebec, the Director of Surveys and the Professor-in-charge of the Survey School of Laval University are both members, and membership has also been taken out by the Secretary of the Quebec Land Surveyors' Association. In Ontario, the surveyors' association has not as yet taken a very active interest in the CONGRESS, but some have become members and we have with us at this meeting today two representatives, both provincial government officials, from Toronto. In western Canada, there are at present a good many American members with headquarters at Edmonton, Alberta, and they have formed a group which no doubt will be spreading the good word there. British Columbia, which is the most westerly of the Canadian provinces, has shown an interest in the CONGRESS from the very start and there are already a few members scattered through this province.

In closing, I wish to thank the Committee very much for having invited me to take part in the program, and for having made it possible for me to attend this very enjoyable meeting.

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The War and Engineering Education

TO CONSERVE certain advantages the war has brought, the Carnegie Foundation is conducting a study of measurement and guidance in engineering education at eleven co-operating higher institutions. The undertaking is sponsored jointly by the Engineers' Council for Professional Development, the Society for the Promotion of Engineering Education, and the Carnegie Foundation, funds being provided by the two engineering bodies and the Carnegie Corporation of New York.

Based on an inventory of the ability and skills which the entering student of engineering is expected to possess, seven special tests are used to appraise his ability and to assist in assigning and guiding him in his training and choice of career.—*Science*, February 2, 1945.

New Mapping Instrument by Corps of Engineers*

By CAPT. D. J. FAUSTMAN†

THE requirements for an instrument by which to obtain accurate and continuous directional control and orientation of rapidly moving elements in modern fluid warfare have been satisfied by the development of the odograph, an instrument that automatically plots the course taken by a moving vehicle. Over a period of years there have been many attempts to develop such a device for rapid route surveys, but a preliminary investigation revealed that none had advanced beyond the planning and experimental stage. The Engineer Board was, therefore, directed by the Chief of Engineers to undertake the basic development and research to produce an instrument suitable for military use.

Because of the large amount of research required, the Army requested the assistance of the National Defense Research Committee, which turned the problem over to three organizations—the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, D. C., the Monroe Calculating Machine Company, and the International Business Machines Corporation. After an intensive co-operative research and test program, models were produced possessing the necessary ruggedness, reliability, and accuracy for military operations. The odograph was then placed in quantity production and the first units were distributed to troops in August 1943.

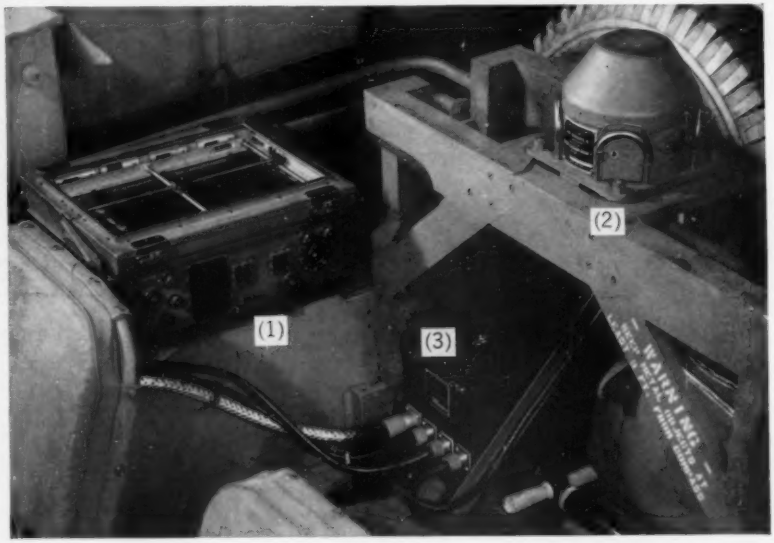
In order to plot a course it is necessary to know the direction of travel and the distance traversed. Thus, a mechanical instrument to accomplish this function must contain (*a*) a distance-measuring element which is moved or turned by an amount proportional to the actual distance traveled; (*b*) a compass element which provides a fixed-reference direction; and (*c*) an integrator which provides for the resolution of the direction of motion into components—one parallel to, and one perpendicular to, the reference direction—and for the summation or integration of the distance components. In other words, the plotting unit of the instrument must perform the mathematical operation of adding up the components of $S \sin A$ and $S \cos A$, where S is the distance traveled and A is the angle of azimuth of the vehicle's heading with respect to the reference direction maintained by the compass.

In the odograph, direction is obtained from a magnetic compass prop-

* Reprinted through the courtesy of Civil Engineering, December 1944.

† Captain, Corps of Engineers, The Engineer Board, Fort Belvoir, Va.

erly compensated for the magnetic effects of the metal of the vehicle, and distance is determined from the speedometer drive take-off in the vehicle transmission. (The vehicle used by the Army is the ¼-ton truck commonly called a "jeep.") The direction indication is transmitted from



ODOGRAPH INSTALLED IN A JEEP

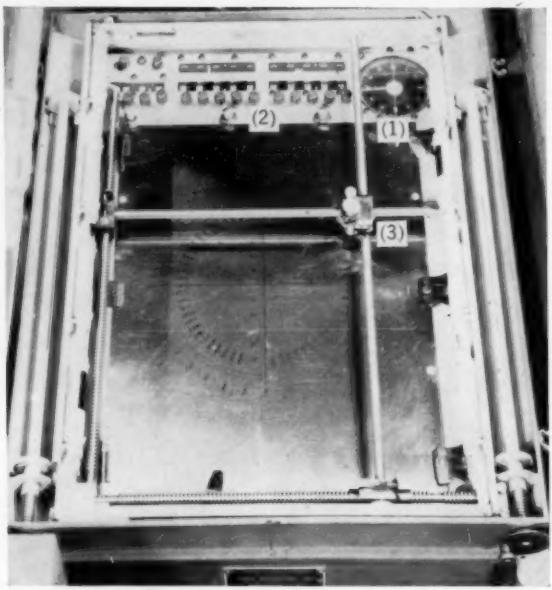
(1) Plotting unit, (2) Magnetic compass, (3) Electrical power pack.

the compass to the plotting unit by a system employing a light beam, photocells, and related electronic control circuits and mechanisms. A vibrator, rectifier-type power pack steps up the vehicle battery voltage for use in the electronic circuits.

Owing to the effect of the vehicle's magnetic field, a magnetic compass in a vehicle will not, unless compensated, line up with the magnetic meridian. As the vehicle is assembled it assumes the character of a single, integral piece of magnetic metal. Actually, however, the intensity and direction of this magnetic field changes slightly as the vehicle is subjected to road shocks, vibration, changes in temperature, and various other causes. Thus, a check on the compass compensation is required every several days. This check is simple to make and requires about 15 minutes. In compensating the compass, the field of the vehicle is considered as

broken down in three components—lengthwise, crosswise, and vertical. Small rotatable bar magnets, appropriately placed with respect to the magnets in the compass, neutralize or compensate for the effect of the permanent magnetic field of the vehicle. In addition, to neutralize the magnetism that may be temporarily induced in the vehicle by the earth's magnetic field, small collars of permalloy are placed so as to balance the resultant mass of the induced iron in the vehicle.

The odograph has an infinitely variable type of map-scale gearing and can plot maps to any scale from 1:20,000 to 1:500,000. The map table will hold an 8½- by 11-inch sheet of paper. Counters are provided which



MAP TABLE OF PLOTTING UNIT
(1) Azimuth dial, (2) Mileage counters, (3) Plotting Pencil.

indicate the number of miles traveled east or west, and north or south, of a given starting point. A means is incorporated whereby adjustments can be made so as to set in the magnetic declination, thus plotting on true north headings. The general size of the various components is observed in the accompanying photographs. The weight of the entire installation is approximately 200 pounds.

Sources of Error

There are several sources of error which reduce the over-all accuracy of the odograph, namely: direction error (compass), distance error, slope-distance error, and mechanical error.

Direction error (compass).—The magnetism of a vehicle changes when the vehicle is subjected to shock. Thus, in driving over rough terrain, the magnetism changes more than on smooth terrain, and a larger error is to be expected. Rough terrain disturbs the dynamic balance of the compass, with some lowering in accuracy because of the fluctuations of the

Compass with Bowl Assembly Raised to Show Phototube System which Transmits Directions to Plotting Unit.

compass card. Compass errors are the major source of error in the odograph, and may amount to 2 percent or more.

Distance error.—The distance input is taken off the speedometer (odometer) drive gear in the vehicle transmission. The distance input will be most accurate when operating on hard, smooth surfaces, with standard tires inflated at the recommended pressure. On loose or rough surfaces, some slippage will occur. The amount of slippage depends upon several factors, and fixed rules covering the many conditions that may be encountered cannot be set up. When a vehicle becomes stuck in soft sand

or mud, the wheels may spin considerably before the vehicle gets out. In such a case, the odograph would be turned off until the vehicle is free. The distance input error may amount to as much as 2 percent under bad conditions of slippage.

Slope-distance error.—The odograph records the actual distance traveled over the ground. In terrain with many hills, the odograph will show a slightly greater mileage than the distance scaled from a map, as the map is a projection of the terrain. It has been found that this error can be regarded as negligible, unless an unusual number of steep up-and-down grades are encountered. For example, a 10 percent grade will give a 1 percent error.

Mechanical error.—A certain amount of play and lost motion exists in the various mechanical gear systems. Close manufacturing tolerances hold these errors to 0.5 percent.

Because of the variable nature of the several sources of error, particularly changing magnetism and wheel slippage, the direction of the error on a given run cannot be predicted. The magnitude of the error, however, can be predicted generally from a consideration of the type of terrain to be traversed. On roads, the errors of closure will average between 1 in 75 and 1 in 200, whereas on rough, cross-country terrain the error will average between 1 in 35 and 1 in 75.

Military Uses of Instrument

The military uses of the odograph may be roughly divided into two classifications:

(1) Map making, or plotting the position of observed objectives relative to a given base.

(2) Navigation, or finding objectives whose positions relative to a given base are known.

By means of the odograph, unknown terrain can be mapped rapidly. For such types of maps, in addition to the plot of the road net, the locations of important points or objects can be plotted either by driving the vehicle to the point, or, if the object is some distance away, by estimating its location with a range finder, or by plotting on the map table by resection. A map can be placed directly on the map table, and, as the plotting pencil moves across the map, the trace formed can be compared with the map to ascertain that the correct route is being followed.

To reach a given objective, the position of which is known relative to the starting point, it is plotted to scale on the map table; and the vehicle is then driven in the general direction of the objective, following roads or other convenient routes. Since the relative location of the objective is always evident from the odograph map, the vehicle can reach the objec-

tive without previous knowledge of the terrain and road net. The odograph has been found to be particularly valuable at night when guiding landmarks are not visible.

As a navigational instrument, the odograph possesses several advantages over the usual means of dead reckoning. The automatic operation relieves the navigator of many duties, or will accomplish dead reckoning when no navigator is present. Any route can be followed, and it is not necessary to follow the route laid out, since wherever the vehicle goes, the plotting pencil will show the actual location relative to the intended route.

NOTATIONS CAN BE MADE DIRECTLY ON THE MAP TABLE.

From a consideration of the function of the odograph installed in the ¼-ton truck, together with a study of its operating characteristics and accuracy, several postwar applications are indicated. In these applications, a comparison with present methods and techniques reveals that with the odograph there will be a considerable saving in time, with resulting economies, and, in most cases, a higher degree of accuracy.

Since it is basically a reconnaissance instrument, the odograph will find its greatest uses in reconnaissance surveying and mapping. As has been explained, an accuracy can be obtained such that the error of closure will be from 1 in 35 to 1 in 200. While the highest degree of accuracy obtained by this instrument is considerably lower than that secured in transit-and-tape surveys, it approaches the accuracy of certain classes of stadia work, and is considerably better than pacing and similar methods.

Adapted to Wide Diversity of Terrain

Because of the high maneuverability of the ¼-ton truck, undue restrictions are not placed on the odograph as to the type of terrain on which it can be used—excepting, of course, rugged mountains or heavy timber. Practically any type of trail can be negotiated by the ¼-ton truck, and for cross-country operations it has no equal. Thus, the equipment will have particular value in all types of route-reconnaissance surveys for highways, transmission lines, and similar projects. This type of reconnaissance survey can be rapidly made, while pertinent data can be noted directly on the odograph map table as encountered en route. Such data include the general rise and fall of the country, possible ruling grades, classification of material, drainage, and limiting ridge and valley lines.

A considerable saving in time and an increase in accuracy will be effected by the odograph, as compared with the usual reconnaissance method of running a line by compass angles and determining distances by pacing, stadia, or chaining. Since the odograph embodies no means of determining elevation, the use of an aneroid barometer is indicated. The odograph trace can be correlated with, and plotted on, an aerial photograph. The infinitely variable map-scale feature makes it possible to plot to the scale of the aerial photograph used.

The odograph is admirably adapted to geophysical surveys for oil and gas. In a general preliminary survey of a large area by gravity or magnetic methods, the odograph can continuously record the location of observations taken with a gravimeter or magnetometer. In this type of work, under present methods the cost of the survey crew may be several times the cost of the geophysical observations themselves. In reflection-seismograph surveys, not only can the odograph be used to plot the position of shot points, but the detectors can be rapidly placed in position by plotting their required position on the odograph map and then driving to the position, as indicated on the map by the plotting pencil. This is the procedure used by a Field Artillery Observation Battalion in setting up a sound-ranging base.

It may be of interest to note that some of the early attempts to develop an odograph were made by designers of geophysical instruments. Geological surveys will be facilitated by the odograph, because various types of soil and rock formations can be traced out, plotted, and thus co-ordinated on the odograph map sheet.

Another profitable use of the equipment will be for highway-inventory surveys. As the odograph is driven over the road, alinement will be automatically plotted, and information on type, width, and condition can be placed directly on the map. Details, such as railroads, bridges, sidewalks, grade crossings, buildings, and homes, can be accurately noted on the map as they are passed.

General area surveys of timber tracts and crops can be accomplished by touring the boundaries, thus making a closed traverse to an appropriate scale. Areas can be determined with a planimeter or by other methods.

Some of the military uses of the instrument will be applicable in postwar operations. For example, the navigation and dead-reckoning features will be utilized for oil-well explorations in barren areas such as Arabia, and for mineral explorations in roadless areas in Canada and Alaska.

The Engineer Board, the development agency for the Corps of Engineers, is directed by Brig. Gen. John W. N. Schulz, President, with Col. W. J. Matteson as Executive Officer. The general responsibility for the development of the odograph was assigned to Technical Division II, with Lieut. Col. W. W. Milner, Assoc. M. Am. Soc. C. E., Division Director. The work was carried out by the Applied Electronics Branch, with Major G. A. Rote, Branch Chief. The writer was in immediate charge of the development and production of the instrument.

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Absolute Altitude Altimeter

AN ALTIMETER that uses radio and electronic waves to measure absolute distances above the ground is being installed in AAF planes to provide a safety factor not available in standard pressure-operated instruments. Supplementing barometric types which record only "above sea level" altitudes, the new instrument acts as a terrain clearance indicator by sending out a radio impulse which strikes the ground and reflects back to the plane. The elapsed time of beam travel is computed automatically and visually registered as absolute altitude on the pilot's instrument panel. In principle, it is similar to bouncing a ball against the floor and measuring the distance by computing known speed of the ball and the time that it takes to hit the floor and bounce back into your hand.

The instrument gives readings of height above terrain on two scales—200 to 5,000 feet and 5,000 to 50,000 feet—as selected by the pilot to suit flying conditions. The system cannot be used with accuracy below 200 feet, since it is difficult to compute the difference between outgoing and incoming electronic waves at that altitude. The major components of the altimeter include a combination radio transmitter and receiving set, a sending and receiving antenna, an automatic computer and a dial to show the indications. Instead of a pointer common to ordinary altimeters, the dial has an electronic circle which bulges into an arrow-shaped pip at appropriate altitude markings.—*Air Force*, March 1945.

Federal Surveying and Mapping Agencies

This is another in the series of sketches of the history, purpose, and scope of activities of federal agencies engaged in surveying and mapping.—EDITOR.

BUREAU OF RECLAMATION*

Department of the Interior

THE Bureau of Reclamation has been making surveys and maps of certain areas in Western United States since the passage of the Reclamation Act on June 17, 1902. The earlier surveying and mapping activities of the Bureau were confined primarily to reclamation projects where engineering works could be built to store, divert, and distribute water supplies for the irrigation of arid lands. With the subsequent growth and expansion of reclamation work, the surveying and mapping activities were gradually extended, as required, to furnish data needed in developing and maintaining projects for other purposes. During recent years, surveying and mapping activities have been conducted to provide basic data needed in designing and constructing engineering works for silt control, flood control, river regulation, hydroelectric power development and transmission, municipal water supply, drainage of water-logged lands, and various multiple purposes, as well as for the irrigation of arid and semi-arid areas. Although prints of completed maps are often supplied to interested parties, on request, the surveying and mapping activities of the Bureau are carried on primarily for the purpose of obtaining data needed in developing and maintaining Bureau projects —not for the purpose of furnishing maps for general use by the public.

SCOPE OF BUREAU SURVEYS

Surveys conducted by the Bureau of Reclamation include practically all types, from preliminary reconnaissance surveys made with hand levels to precise surveys made with theodolites and precision levels. They include preliminary surveys for project planning, more accurate surveys for design purposes, and final location surveys for construction control. They also include various special surveys required in connection with the development of project lands, the maintenance of project structures, and the prosecution of certain Bureau enterprises.

In general, investigations of a preliminary nature may include sur-

* Prepared in the Office of the Chief Engineer, Denver, Colorado.

veys of land and property lines, topographic surveys of project areas, topographic surveys of dam and reservoir sites, measurements of canyon cross sections at alternative dam sites, measurements of river slopes, determinations of river discharge, hydrographic surveys at existing lakes, soil surveys of irrigable lands, and geologic investigations at dam and reservoir sites. They may also include determinations of ground-water levels in seeped areas, measurements of silt loads carried by river flows, surveys of silt deposits in existing lakes and reservoirs, measurements of evaporation losses, and investigations of other special conditions or phenomena involved in the preparation of project plans.

Surveys of a more accurate nature are required for use in working out detailed designs for project distribution systems, storage structures, and various appurtenant works; also for controlling construction activities and computing contract quantities during the building of a project. Project features for which such surveys are needed may include storage dams, spillways, outlet works, power plants, pumping plants, pipe lines, transmission lines, railroads, roads, highways, bridges, buildings, drainage canals, tunnels, irrigation canals, and various canal structures.

Special surveys required in connection with reclamation activities may include determinations of river-channel erosion, measurements of silt movements along reservoir beds, measurements of rock deformations caused by the building of high storage dams, determinations of ground surface movements caused by the filling of reservoirs created by such dams, and surveys of deflections, tilting, and other distortions at major Bureau structures. Special surveys may also include various watershed investigations, hydrological measurements, and surveys of accumulated snow cover in mountainous territories for use in forecasting flood flows and estimating total seasonal runoff. In some cases, as at Boulder City and Coulee Dam, surveys have been made for use in laying out permanent town sites and constructing entire cities, including streets, sidewalks, parks, homes, store buildings, schools, hotels, and all types of public utilities.

Surveying Methods

The methods used in conducting Bureau surveys vary with the kind of survey, purpose for which it is intended, degree of accuracy required, and nature of the area covered, particularly as regards steepness of canyon slopes and density of timber covering. The more usual land surveys are made with levels, transits, and planetables. Stadia methods are frequently used in making topographic surveys of dam and reservoir sites. Theodolites and precision levels are used when an unusually high degree of accuracy is essential. Triangulation methods are used in establishing control points. In conducting surveys at dam sites located in

canyons with precipitous or nearly vertical side walls, as at Boulder Dam, it often is necessary to support the surveyors by ropes or cables suspended from the tops of cliffs. In some cases, new types of measuring equipment have been designed and manufactured for use in special surveys; as, for instance, tiltmeters, designed and built to measure the tilting of massive concrete dams and the deformation of rock foundations.

Wherever possible, surveys of a reconnaissance or preliminary nature are tied in with corners previously established by the General Land Office. More accurate surveys are tied in with bench marks and control points of the United States Geological Survey or the United States Coast and Geodetic Survey, if such markers are available in the areas under investigation. If no accurately located bench marks or triangulation monuments have been established, the Bureau conducts such precise surveys as may be necessary in order to supply satisfactory control points for the Bureau's work.

Bureau of Reclamation surveys that require most exact methods of measurement include: (1) location and establishment of bench marks and monuments to serve as control points; (2) location of relatively long tunnels through mountain ranges; (3) determinations of the settlement of the earth's crust at the bottom of newly filled reservoirs, caused by the weight of the stored water; and (4) determinations of movements at completed concrete arch and gravity dams, including tilting, upstream and downstream deflections, tangential movements, vertical movements, opening and closing of contraction joints, rock deformations along the foundation and abutments, volume changes in mass concrete, and other distortions which are of relatively small magnitude but which are important in considerations of structural and operational safety.

Thus far, surveys classified under item (4) have been made at Gibson, Owyhee, Boulder, Friant, and Shasta dams. Surveys noted under item (3) have been made only at Lake Mead, formed by the construction of Boulder Dam, and at the reservoir on the Columbia River, formed by the construction of Grand Coulee Dam. At Lake Mead, a settlement of about five inches was found to have taken place under the main part of the accumulated storage. At Grand Coulee Reservoir, the measured settlement was too small to be accepted as a definite movement, considering the uncertainties involved in its determination.

Examples of precise surveys classified under item (2) include those made in connection with the location and drilling of the 13-mile Alva B. Adams tunnel through the Rocky Mountains near Estes Park, Colorado, required in developing the Colorado-Big Thompson power and irrigation project. This tunnel, which passes through the mountains at elevations varying from 8,250 to 8,358 feet above sea level, required the extension of precise surveys across the Continental Divide at elevations as high as

13,000 feet above sea level. It is interesting to note that when the tunnel excavations from the two ends were holed through, the survey lines were found to check within 0.037 foot in alinement and within 0.062 foot in elevation.

Mapping Activities

Mapping activities of the Bureau, like surveying activities, are conducted primarily to supply the needs of the Bureau in planning project developments, designing and constructing reclamation works, maintaining engineering structures after completion, and operating the project systems. Some general maps of reclamation regions, projects, and certain drainage basins are printed in colors and are available for distribution to project residents or other interested parties. In a few cases, such as some of the earlier Colorado River investigations, surveying and mapping activities were conducted in co-operation with the United States Geological Survey, and the final preparation, printing, and distribution of the maps was handled by the Geological Survey. However, most Bureau maps are prepared for use within the Bureau and are not intended for general distribution. Some of the more general maps, prepared on the basis of preliminary surveys or compiled from existing data, are used as exhibits in reports on contemplated projects. In some cases, these reports are submitted to the Congress of the United States and are later printed in Senate and House Documents. Some maps showing locations of engineering structures, topographic conditions, geologic formations, and other pertinent features, are included in printed specifications for construction contracts.

On special occasions, large wall maps are prepared for use in lectures, to facilitate the presentation of data at court hearings, or for general display purposes at conventions, society meetings, or other public assemblies. Such maps usually are of a general type, showing only the more important project features of public interest or the particular points under consideration at the time of the display.

Because of the many different kinds of work in which the Bureau of Reclamation is engaged, maps prepared by the Bureau, like surveying activities, cover a wide range of type and purpose. They include general maps of drainage basins, river courses, project areas, project subdivisions, and special territories involved in Bureau developments. They include topographic and geologic maps of reservoir sites, dam sites, and tunnel locations; also maps of other local areas to be occupied by the construction of major engineering works. They include maps showing detailed locations of the project features mentioned under "Scope of Bureau Surveys." In some cases, maps showing land classification, ground-water levels, seeped areas, silt deposits, town sites, and other special features are required in connection with Bureau enterprises.

In preparing Bureau maps, a base or network is first compiled on the basis of actual field measurements, General Land Office surveys, or available coordinate system data. Items of specific information to be shown on the map are then assembled, adjusted, and fitted on to the prepared base. In the case of topographic maps, contour lines are located by the usual methods. Preliminary copies of the maps are prepared in pencil, on vellum or other suitable sheets, and are then traced, so that prints can be obtained as needed. All map tracings are hand-drawn and usually are free-hand lettered. Due to the present shortage of experienced tracers, some lettering is done by mechanical processes. A simplified system of lettering, following the standards adopted by the Geological Survey, is used in preparing Bureau maps.

A few years ago, the Bureau of Reclamation had some surveying and mapping activities conducted by aerial methods, under contract, primarily as a test program, to ascertain if such methods could be satisfactorily applied to Bureau work. However, the war and the ensuing emergency conditions throughout the country prevented the continuance of the tests. When conditions return to normal, it is possible that advances in aerial mapping procedures made during the emergency period may be found adaptable to the needs of the Bureau.

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Model Helps in Solution of Hydraulic Problem

AIDING in the location of the Delta Cross Channel of California's Central Valley Project, the proposed fresh water channel through the common delta of the Sacramento and San Joaquin rivers, was a scale model of the Delta region constructed in the Bureau of Reclamation's hydraulic laboratory in Denver, Colo.

Various conditions of river stage and ocean tide were simulated by flowing water into channels of the model. Tides were produced by a specially designed pump, and by using colored water repellent action of fresh water flow against tide water was observed. The purpose of the channel is to transfer water from the Sacramento River to the San Joaquin Valley for irrigation purposes, and to flush into delta channels a flow of fresh water to repel incursion of salt water.—*Engineering News-Record* (News Issue), March 15, 1945.

The Employer's Point of View on Qualifications for Surveying

By PROF. F. W. PEARCE*

THE PURPOSE of this paper is to disclose information obtained from a Questionnaire which was sent out to civil engineering employers to ascertain the deficiencies they observe in the professional training of young engineers and those engaged in surveying. Specifically the Questionnaire requested the following information:

I. What surveying operations are carried out by your organization and state the frequency of their occurrence?

(Operations listed)

II. What are the principal shortcomings you find in recent engineering graduates you employ?

III. What are the principal shortcomings you find in recent engineering graduates' surveying training?

IV. State any suggestions you may have whereby the engineering colleges may co-operate in preparing better trained graduates.

The data of the Questionnaire were obtained from engineers of cities; members of engineering firms; departmental heads in engineering divisions of railroad companies, state highway departments, and Federal Government Departments throughout the United States. It is gratifying to note that there has been evinced so much interest and co-operation in replying to this Questionaire. This is especially true in regard to Question No. IV where many helpful comments were made.

Compilation of Results on Questions I–III

Question I

Of the Surveying Operations listed, the results showed that Grade stakes, Profiles, Alignment, Cross sections, Vertical curves, and Circular curves, occurred *frequently;* Property surveys, Slope stakes, Topographic surveys, Traverses, Instrument adjustments, and Stadia, occurred *occasionally;* while Triangulation, Spirals, Solar determinations, and Polaris determinations were *rare* in their occurrence. The order of occurrence was as listed.

Question II

Of the principal shortcomings in recent engineering graduates the

* Head of Engineering Department, Northern Montana College.

following occurred *frequently* in the poll in the order listed:

Little conception of work to be done
Lack initiative
Lack confidence
Inability to use good English

while the following occurred *occasionally:*

Difficulty in following written instructions
Not co-operative
Poor mathematical background

Question III

Of the principal shortcomings in recent engineering graduates' surveying training, the following occurred *frequently* in the order listed:

Thoroughness is not given proper emphasis
Good technique in field work has not been stressed
Good lettering has not been sufficiently encouraged
Inaccuracy has not been curbed
Unsystematic methods of working are evident

while the following occurred *occasionally:*

Mathematical computations are not reliable

Replies to Question IV

The number and length of some of the comments received in answer to this Question would prohibit the use of all but a small part of these in this paper. Also, there were many duplications and repetitions to these answers. These comments have therefore been generalized under two divisions, and are followed by a third division giving extracts from some of the replies, particularly as they relate to surveying.

A. Recommendations for Improving the Engineering Curriculum

1.* Intensive and thorough training should be given in mathematics, chemistry, physics, drawing, and mechanics (including hydraulics).

2.* Accuracy, thoroughness, neatness, and the necessity of checking results at every opportunity should be insisted upon in every course in the engineering curriculum. The habit of thinking and of placing greater confidence in ability should be instilled. Also, students should be trained to find information and to use it.

* These comments occurred more frequently than the others.

3. The following topics should be discussed in a seminar, orientation class, or other class: ability to sell one's self; employers' point of view; job interviews; the handling of men; ethics; traits of character; public relations; licensing of engineers and land surveyors; and life beyond college in field pursued. Students should be encouraged to take part in civic organizations. The desirability of reading technical magazine articles regularly should be strongly emphasized.

4.* More emphasis should be placed on the teaching of English and public speaking in engineering colleges. Speeches as well as written and oral reports are frequently required of engineers, and these requirements should be prepared for in college. Also a specific course in report writing is desirable.

5.* More consideration should be given to drafting, freehand drawing, and lettering. Attention should be given to the reading and understanding of blueprints as well as to neatness, completeness, and accuracy of drawings and design notes.

6.* Engineering training should be training for leadership. Originality and resourcefulness should be encouraged. Engineers want men with perspective, initiative, ingenuity, and energy. Therefore colleges should train students with the above-mentioned attributes in mind.

7. Courses in business, real estate law, shorthand and typewriting should be pursued by engineering students. The survey showed considerable emphasis placed on shorthand and typewriting.

8.* An engineer should be something more than a good technician. It is recommended therefore that his education be as broad as possible, including some cultural subjects such as logic, economics, finance, public speaking, government, history, geology, biology, and sociology. Some of this training can be taken care of in a seminar or other course. A liberal arts education before graduation from an engineering college is ideal. Cultural subjects are most desirable for those who go into supervisory and administrative work.

9. Consideration should be given to the training films and training devices adopted at present by the Armed Forces for superseding to some extent, at least, the lecture method.

B. Recommendations for Improving Surveying Training*

In general more attention should be given to surveying instruction in engineering colleges. In this respect the following suggestions were made:

1. Make courses as practical, thorough, and comprehensive as possible, and conforming to present and future trends.

2. Stress the need for care, dissembling, and adjustment of instruments.

3. All engineers should be schooled in surveying.

4. Summer surveying camps or equivalent should be made compulsory for civil engineering students.

5. Equal stress should be placed on both land and construction surveying.

6. The study of errors should be given very careful attention.

7. More attention should be given to neatness, thoroughness, accuracy, and adequacy of field notes.

8. More attention and instruction should be given to the technique of field work.

9. The principles of photogrammetry should be studied.

10. Students should have instruction and practice in the writing of specifications for surveys.

C. Extracts from Replies

The following excerpts are from city engineers:

1. "In the senior year, require the students to plot their elementary surveying notes and then design a structure such as a bridge, sewer, or building to fit this survey."

2. "College courses in engineering may be improved by laying more stress on construction surveying. Practically all text books approach surveying from the objective of determining the location of the things that exist and give scant attention to the application of surveying to the location of structures for the purpose of building them. I have been an instructor in surveying for many years, and in all of my courses equal stress is laid on both land and construction surveying."

Here are a few comments from members of engineering firms:

1. "The student should be made to realize that good surveys are essential to good engineering planning. An engineer can not serve his client unless he can plan the survey that will best serve the purpose for which the survey is being made and execute it economically. Every survey is different and specifications covering the survey should be written before the survey is commenced."

2. "Cultivate and encourage originality when you find it."

3. "One thing I have noticed so much among engineers in our work is their inability to co-ordinate the field information to be obtained with the use that is to be made of that information when it comes into the office. We have found that accuracy and neatness are very essential for field men."

Certain engineers of state highway departments expressed themselves as follows:

1. "In emphasizing accuracy, care must be taken to avoid losing sight of the general picture by getting lost in details."

2. "Teach the civil engineering student that surveying is fundamental, that it

increases his sense of proportion and understanding of the primary factors in his decision of later years."

3. "The average graduate is a rather poor draftsman, with little knowledge of the short-cut methods used in the drafting room, and in the field, as is to be expected."

One Federal Government official stated:

"This Office is gradually changing its mapping methods to take full advantage of the benefits that are derived from the use of aerial photographs. The application of this method in the civil engineering field indicates the desirability of engineering colleges giving instruction in the use of photogrammetric methods."

In summarizing the above recommendations, it seems to be generally conceded that there should be more thorough college training and practical application, whenever possible, in drafting, lettering, surveying, English, public speaking, business courses, and cultural subjects. In line with this trend of thought and consistent with the preceding recommendations, marked approval is manifested, in the Questionnaire, of the stressing of engineering fundamentals. These fundamentals are listed as mathematics, chemistry, physics, mechanics, and drawing. Contrary opinions to these recommendations are few. Some insist that, if colleges can teach students to think, nothing more should be required of the institutions.

If the writer were to add any further remarks to this article, there would be five. First, he would state that the subject of errors is of basic importance in surveying. In correlation with this statement, Professor Rayner[1] states in a recent article that more attention will have to be given to this subject in the future due to the greater emphasis placed on accuracy. Second, he agrees with Professor Kissam[2] in a recent paper that the important men on a project are those who are able to apply principles and effectively carry out the work simultaneously. Third, in conforming to present and future trends Professors Rayner and Zelner[3] both verify the opinion, stated earlier in this article by the United States Government official, that there will be rapid developments in photogrammetry before too long. Fourth, in full accord with Professor Zelner, the results of this Questionnaire also indicate that no radical changes have been recommended in subject matter or teaching methods. Fifth, the writer is inclined to think that not enough time has been spent in writing specifications for the surveying operations in the past.

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[1] Education in Surveying and Mapping after the War, SURVEYING AND MAPPING, October 1944.

[2] Paper presented at meeting of the Surveying & Mapping Division, A.S.C.E., January 21, 1944.

[3] Education and Training in Surveying and Mapping, SURVEYING AND MAPPING, October 1944.

PROJECTION RULING MACHINE OF THE U. S. COAST AND GEODETIC SURVEY

The Projection Ruling Machine of the U. S. Coast and Geodetic Survey

By STEPHEN ROSE*

EVER since it has been established that the planet on which we live is round and not flat, the greatest problem besetting the map maker has been the representation of the physical features of the earth upon a flat surface. To solve this problem cartographers have devised systems of map projection by which the imaginary lines of latitude and longitude are arranged in an orderly and systematic fashion. By means of these the map user at once becomes aware of the geographic location of the area represented by the map. The precise determination of these lines is arrived at by geodetic and astronomic processes. Since a draftsman's error of one-twentieth of an inch on a scale of 1:10,000 corresponds to a displacement of nearly forty-two feet on the ground, it is obvious that if the field precision is not to be wasted in the final drawing of the map, the projection lines—to which all map-detail is tied—must be engraved as closely as possible to their theoretically correct positions.

Formerly, all projections in use in the Coast and Geodetic Survey for compiling maps and charts were drawn by hand. The use of distortion-free aluminum-mounted sheets for chart compilation and planetable surveys, and the construction of a precision copying camera capable of reproducing maps and charts to the nearest 0.002 inch, disclosed the need for a projection ruling machine with which it would be possible to draw a projection or grid with line displacements not exceeding this amount—a result difficult of attainment by hand with any degree of facility.

The Projection Ruling Machine illustrated was designed in the office of the Coast and Geodetic Survey and constructed under contract. It was put in operation in October 1934, and since then thousands of projection sheets have been made with it. As far as is known, it is the only machine of its kind in the world.

In its present construction the ruling machine is capable of drawing curvatures of latitudes on projections as far north or south of the Equator as the sixty-fifth parallel on scales not smaller than 1:500,000. An attachment now being designed will make the machine adaptable for any scale and any curvature, and will be effected by plotting a series of points through which a smooth curve can later be drawn by hand. Even azimuthal projections will become a possibility with this attach-

* Chief Engineering Draftsman, U. S. Coast and Geodetic Survey.

ment. The largest size projection that can be drawn with the machine is 43 by 61 inches.

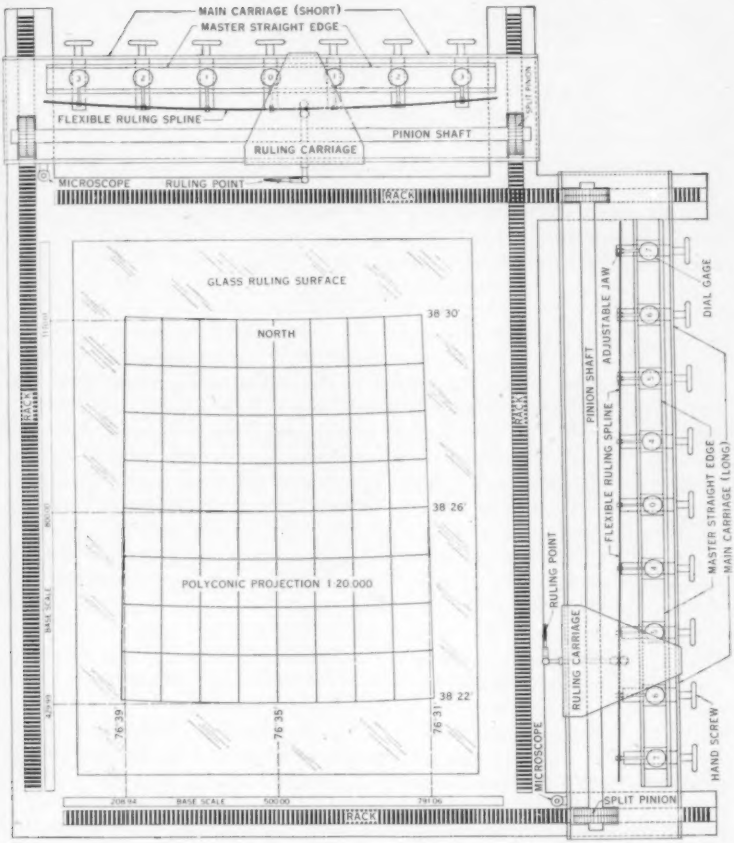
Description

In size and shape the machine resembles a billiard table. The body is of cast iron and rests on heavy metal legs. The inside is hollow and is fitted with fluorescent lights. The central portion of the table is of plate glass—three-fourths of an inch thick—making it suitable for use as a light-table when transparent drafting bases are used. Most of the work done on the machine, however, is lighted by fluorescent fixtures placed several feet above the table.

Along each edge of the machine is a track with a cut-in rack. Each pair of parallel racks accommodates one of the two main carriages which are engaged to the racks by means of brass pinions. The pinions are split, with one-half of each pinion floating on its shaft and pressed with strong springs against the opposite side of the tooth to which the half fixed to the shaft is engaged. This prevents "lost motion" and insures that the movement of each carriage is parallel with its own rack-track and perpendicular to the movement of the other carriage. Two-foot overhangs along two adjacent edges of the machine permit the main carriages to be brought to their "home" positions entirely clear of the table top.

Mounted on each main carriage, and free to move throughout the entire length of each, is a ruling carriage which supports a ruling point. This carriage always moves parallel to the pinion shaft of the main carriage, but the ruling point does not—its direction of motion being determined by a flexible steel spline which forms the ruling edge. A series of adjustable jaws, equally spaced, clamp the spline and adjust it for curvature or convergence of the projection lines. Fixed to each of these jaws is a dial gage, or indicator, which registers the lateral movement of the spline to 0.01 millimeter. It is possible to move, or bend, either end of the spline as much as 31 millimeters from its normal position. It must be remembered, of course, that the center of the spline is not fixed and the entire spline may be moved in either direction laterally, so that either spline may be made parallel with the pinion shaft, tilted in either direction, or curved at varying degrees in relation to the pinion shaft. The jaws controlling the spline are located along a master straightedge which is graduated in millimeters and which has verniers on the dial gages, by means of which the gages may be set at any desired interval along the straightedges.

Stainless steel bars—graduated in millimeters, and with a negligible coefficient of expansion—are located on two adjacent sides of the ruling machine, between the edge of the glass ruling-surface and the rack-track.



SCHEMATIC DIAGRAM OF PROJECTION RULING MACHINE.

With the aid of these bars, the main carriages are precisely set for the ruling of the projections. A high-powered microscope is fixed to each main carriage for magnifying the graduations of the millimeter bar. Each millimeter is divided into tenths by graduations etched in the microscope lens, further subdivision being made by estimation. A slow-motion screw attached to the main carriage assures microscopically accurate settings.

The machine is adaptable for use with any drafting medium—drawing paper, acetate, metal-mounted Bristol board, glass, copper, brass—the only change necessary being the type of ruling point used. This may be an ordinary ruling pen, a phonograph needle, or a steel or diamond point, depending upon the drafting base used and the depth and width of the impression required.

The Projection Ruling Machine and the drafting bases are kept in a room which is air-conditioned in summer and humidified in winter. A hydrothermograph is in use, and psychrometer readings are taken at half-hour intervals to make certain that the humidity of the room does not vary excessively.

Operation

To construct a projection, the usual data must be taken from the projection tables and a lay-out made similar to that made for a hand-constructed projection. By means of specially prepared equations, the projection data are transformed to settings on the machine. The computation of grids is done in a similar manner. All computations are made with an electric calculating machine. The entire data needed for an average projection, plus the grid, can be computed in an hour. A 1:20,000 scale projection with every minute-line ruled can be constructed in less than an hour.

In addition to its use for constructing projections, the Projection Ruling Machine may also be used for checking grids and points already plotted. This is done in the following manner: A microscope fitted with a cross-hair lens is mounted on each ruling carriage. The main and ruling carriages are then moved into position so that the line or point to be checked coincides precisely with the cross-hair intersection. The main carriage is then clamped and its position recorded by reading the millimeter bar. For checking a grid system, readings are taken along the grid lines, the mathematical differences between the readings determining the correctness of the grid. If a plotted point is to be checked, readings are taken with both carriages. The two readings give the position of the point. The next step is to tie in the readings mathematically with any other known point or with any projection line.

From the time the Projection Ruling Machine was first put into operation in 1934 to the present time, many thousands of projections and grids have been constructed with it. Since August 1942 alone, 5,284 projections on copper, glass, plastics, and paper have been made on the machine, most of which were for the Armed Forces and for other agencies engaged on the War Mapping Program. This expedited in no small way the essential mapping program and with a considerable saving in manpower hours.

The Mackenzie River Mapping Project

By DANIEL J. GEE, Cadastral Engineer

IN early 1943 Army engineers realized that the need of oil for its northern fighters in the Pacific area was very necessary and so looked around for a source that would supply the need. From reports that promised to supply those needs with only the opening of an already proven area, the Army Planning Board decided to develop the Mackenzie River oil basin and pipe the vital fluid direct to the base of operations. The job was a difficult one to tackle due to the lack of maps accurate enough to pick out a route to lay the pipe line.

The area to traverse was practically virgin country, where only a few hardy souls had ventured and made compass maps of the area within sight as they went along. The Mackenzie River itself had been traversed by the Canadian Government surveyors from the Peace River Junction to the Arctic Ocean, taking in an area 10 miles wide which was projected up through an enormous area which consisted of the Northwest Territories. Almost nothing was known of the 600 miles lying between Norman Wells on the Mackenzie River and Whitehorse in the Yukon Territory.

A request for maps of this unknown area was made and the maps were produced by cadastral means. The U. S. Army Air Forces, using seven bombers equipped with trimetric cameras, covered the area from just north of Edmonton, Alberta, Canada, to the Arctic Ocean in less than one month. Main rivers were meandered and the parallel flights were laid out 30 miles apart. Every 100 miles a diagonal flight was made to cut the parallel flights into quadrilaterals. By using the Mackenzie River traverse furnished by the Canadian engineers as a base control, the flight strips were assembled by radial line control and reduced to the proper scale for mass assembly.

The area covering the Mackenzie River oil basin and the area needed to lay the pipe line were drawn up first, using the oblique photos with conversion grids to fill in areas between the vertical assemblies. The maps were made on the polyconic projection and the pipe line traverse measured off and plotted between the wells and the refineries at Whitehorse. Solar observations were made by the field crews along the pipe line traverse for check purposes on the geodetic grid. The maps for this area, covering 160,000 square miles, were made from 34,000 photos, including vertical and oblique shots.

This job, which was ordinarily set up to keep 20 good photogrammetrists busy for 2 years on office assembly, was handled by 5 men in 9 months, who did a job that will be used for years to come.

Property Surveys Division

EDITOR'S NOTE.—The material for this issue of the Property Surveys Division has been asembled by C. E. Hanson, Associate Editor of the Division.

A PROBLEM FOR LAND SURVEYORS

Submitted by J. H. HOLMQUIST
Registered Land Surveyor, Rockford, Illinois

ON THE accompanying plat (fig. 1) I have shown a block in a subdivision with our measurements (in parens.) and the original dimensions of the block and lots.

The corners of *C* Street were chiseled "*X*'s" found in the concrete walk and on *A* Street ¾-inch iron pins were found. Some surveys had been made in this block previous to our recent one; some as far back as 1907. The original subdivision was laid out about the year 1885, when the lots were supposed to be 66 feet wide, excepting lots 9 and 18, which called for 55.44 feet each, the intention being to have all lot lines parallel. However, such is not the case now as the plat shows. You will note that most of the surplus is given to lots 9 and 18. The only thing we could figure out was that, either by occupation or by finding some of the original pins, the surveyor who surveyed a lot in 1907 came to the conclusion that the surplus should be given as we show it. This is a little out of the ordinary as far as distribution of surplus in the entire block is concerned.

I had a copy of the plat which was in our office, and showed allowance of surplus, which we followed quite closely.

Would any of the members care to comment on it?

ASSOCIATE EDITOR'S NOTE.—The problem posed by Mr. Holmquist was submitted to several members of the Property Surveys Division in different parts of the country. Their comments which are presented here reflect the individual integrity, initiative, and skill embodied in the property surveying profession. Practical problems such as this and their solution will greatly stimulate the surveying and mapping profession to look to the CONGRESS for guidance. The harnessing of the "Professional Procedure" as practiced by surveyors throughout America would be a valuable asset in solving complex boundary problems.

FROM THE EAST

CHARLES A. CAHN.*—With reference to Mr. Holmquist's problem and

* Civil Engineer and Surveyor, New Haven, Conn.

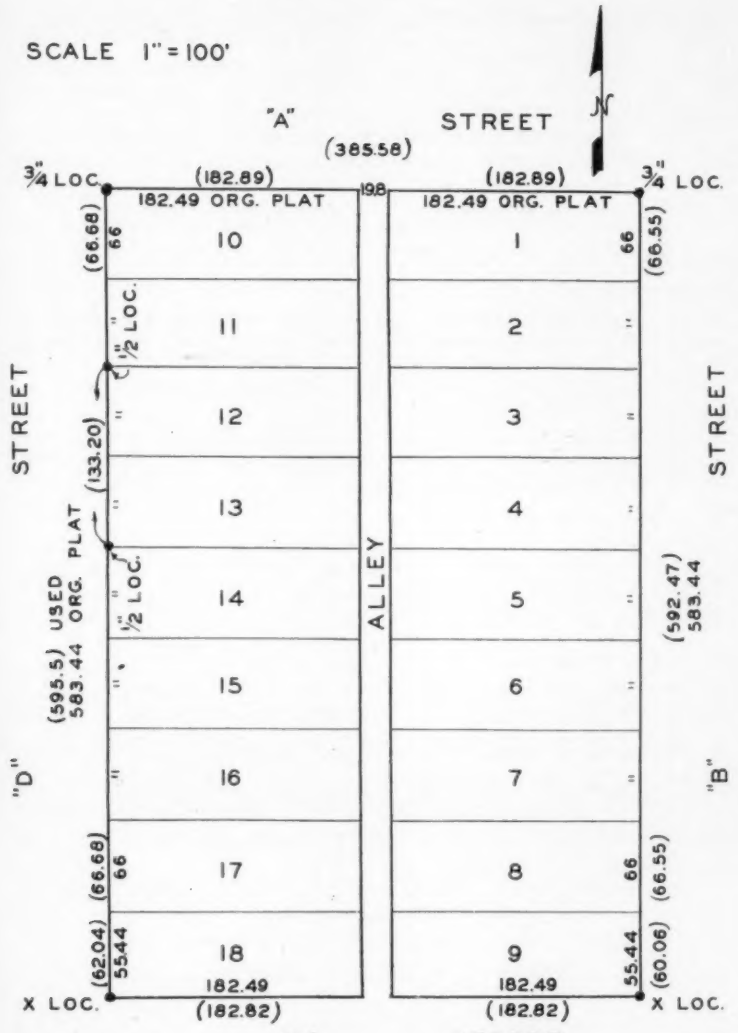


FIGURE 1.—A problem in distribution of surplus.

others of this character, my "Professional Procedure" is as follows:

1. *Preparation of the Job*

(*a*) An abstract of all deeds of the block out of a common ownership, particularly being sure to set them up in chronological order.

(*b*) Collection of old measurements—from old atlas, my own office (or that of competitors with whom I exchange data), old maps, pavement assessment frontages, sewer assessment frontages, present tax assessment frontages and depths.

(*c*) Street line data,—particularly with reference to the chronological order in which streets were laid—street line takings, and street line narrowings.

2. *Analysis of the Job*

(*a*) A thorough study of the above should be made, comparing old measurements with the deeds and understanding the order out of the deeds, so that as far as possible a picture is gained of the order of development of the block and as far as possible attempting to retrace the steps of the original developers.

3. *Survey*

(*a*) An actual survey of ground conditions, covering as much of the block as will be helpful in understanding Step 2.

4. *Analysis of the Survey*

(*a*) A complete and thorough study of the existing conditions as compared to the data revealed by Step 1 and the study of Step 2. This may sometimes reveal that conclusions previously reached in Step 2 are in error; an open mind must prevail until a decision is made herein.

5. *Staking and Mapping*

(*a*) Staking based on the decision of Step 4 and the making of a map thereof. Be sure to see the map is checked by at least two persons.

With reference to Mr. Holmquist's problem, data for Step 1 is missing, so that I do not believe it is possible to come to any conclusion about it.

However, taking the answer and working backwards, one might find the following conditions:

(1) *A* Street was laid out prior to *C* Street.
(2) Lots 1 to 8 inclusive and 10 to 17 inclusive were absolute in dimensions.
(3) Lots 9 and 18 were more or less in dimensions.
(4) Lots 9 and 18 were the last lots out of the common ownership.

These conditions would give the answer as it exists today.

The surplus of 7 feet in lot 18 is larger than the average one you would expect to find in a city lot in these parts. Yet I have seen one case where the end lot ended up 20 feet short, as the original developer measured his

plat on the slope and the lots when laid out were measured on the horizontal on the ground; thus the end lot, which was the last one out by deed and the last one worked physically and had more or less dimensions, absorbed the shortage.

In the writer's opinion Steps 1 and 2 are the very foundation of a survey and without them the finest field work possible is like a beautiful yacht on a turbulent sea without a helmsman.

FROM THE MIDWEST

E. H. OWENS.*—A solution of this problem is impossible on the data furnished, insofar as an opinion as to any particular line is concerned. Excess must be distributed between the nearest original corners which can be proven. These may be proven, (1) by the original marker if mentioned in the plat and dedication; (2) by testimony as to the original location of the line (in this connection, evidences of possession such as fences recognized by adjoining owners, or buildings built to the line are to be considered as supplementary and confirming evidence); and (3) if corners cannot be proven by testimony or local evidence, it is permissible to measure to the nearest proven corners and distribute the excess or deficiency.

The location of street improvements has the same weight as a fence for they are located by the municipality which has an interest in the street exactly equal to that of any other property owner. Efforts to distribute excess from one street to the next have been rejected by the Missouri Supreme Court where this does not conform to evidence as to use and original location as to intermediate lines. It must be remembered that street improvements are usually on a compromise location which will keep a reasonably straight line and dodge between adjacent additions and may never have been intended to coincide exactly with the center of the dedicated street.

In the problem submitted the street does not seem to conform to the platted addition; but if the street was dedicated by the plat, the mere fact of non-use would not vacate the street or any part of it, unless the trend of travel was entirely closed and the owner of the corner lot would use the abandoned strip of land at his own peril. On the other hand, if the street was opened first and the plat recited that the street was a boundary of the addition, then there would be grounds to consider the street as one starting point, if it has not been moved since the dedication.

The use of crosses on the sidewalk or iron pins found in the ground, the origin of which is unknown, is utterly without foundation. These

* Registered Engineer, Kansas City, Mo.

must be supplemented by the testimony of the person who placed them, or of property owners who have used them, as a means of proving the location of original control marks.

JOHN S. DODDS.*—This is the sort of problem we like to have presented at our Iowa surveying conferences. At our conferences we would ask Mr. Holmquist to place the plat upon the blackboard giving additional information as to the place of the block in the subdivision and all street widths in relation to this subdivision, and the block and the location of the subdivision in the section and township. We would also like to consider occupation of the property and existing hedges, fences, as well as location of buildings and their probable length of occupation. Then various deductions are drawn.

Many surveyors operated and still do upon the premise that all excess or deficiency found in a survey should be thrown into the part shown as fractional in the original survey in spite of the long established principle laid down in Morland vs. Page (Iowa 2—1855) that each part of a subdivision is entitled to the proportional part of the whole represented by the measurements as shown upon the original plat.

FROM THE WEST

WM. C. WATTLES.†—The problem submitted by Mr. Holmquist is frequently encountered in California, and often presents a big obstacle to solution. Occasionally no solution is possible except to abandon the original record and create a new set of boundaries either by agreement and quitclaim deeds or by court action.

There are three bases for location of the lots:

(1) Relocation from the record.
(2) Location of areas which may ripen into title by proper legal procedure.
(3) Location which a Title Company considers insurable. Of these, (2) and (3) are very variable and introduce factors outside the consideration and analysis of survey designed to re-establish the original record boundary lines; the discussion here will deal only with (1).

There are three factors of error to be considered in the submitted problem, any one or more of which may cause the discrepancies shown by the recent survey. If the source of error can be determined, then a reasonable relocation of the original positions can be made:

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* Professor of Civil Engineering, Iowa State College.
† Licensed Surveyor, Los Angeles, California.

(*a*) Variance of original block boundaries, in actual ground position, from street lines as now accepted.

(*b*) Mathematical or clerical error in dimensions on the map, differing from the field and office work originally done.

(*c*) Variance in actual measurements between same points in old and new work, due to tape differences; also a possible variance in instrument work.

Of these, (*c*) can be ignored here as the plat shows no consistency in difference of record and corresponding new measurements; it is rare that old and new tape distances between same points differ more than one or two tenths per hundred feet, and usually only one or two hundredths.

The first place to seek the trouble is in (*a*). Has the present street location been thoroughly checked against original monuments or related lines, and the center lines extended far enough to show consistency of error or agreement in adjoining blocks comparable with this one? It is quite possible to determine that one or more of the block boundaries is definitely not in agreement with the record, indicated by either angular or distance measurement to adjoining lines. If this be the case then such lines must be discarded in the relocation analysis and record distances run from the accepted boundaries, throwing all discrepancy against the faulty lines. If no exterior lines are acceptable, and no interior lines can be identified then the problem is insoluble. If one or more interior lines can be established by known original monuments, witnesses, or replacements, then the remainder lines are fixed by running the record out and away from such lines.

Examination of the plat raises a suspicion that the widths of lots 9 and 18 are in error on the record by 10 feet, since that is the approximate difference of old and new totals in the block. If *A* Street is acceptable as the original position, and *C* Street shows off, it is fairly conclusive that error exists on the south line; since the plat indicates lots are to be regular except the south lots, it would be proper to run the record from the north, throwing all discrepancy in the south tier.

Since the position of the stakes set about 1907 are not of record, in the sense of filing a recorded map of their positioning, they have no bearing or application in the analysis of relocation.

The east and west location is probably satisfactory, since it is symmetrical, although showing considerable excess over record.

The method of prorate of dimension for intermediate lot lines, frequently used, is not justified here; excess of the amount shown here is not a proratable quantity, since proration presumes only a variance between old and new chaining, and is not usable to correct error in fact.

To fix a relocation of the *record* of this block, requires a full and complete examination of all facts, both physical and record, and full analysis of all factors. The theory of majority probability should be followed.

As stated above, this problem, as presented, does not concern itself with the position of boundaries which might be established by a ripening of title; such is quite a different thing and depends on matters outside the record as well as of record.

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Churchill on the "Chartered Surveyor"

CONCERNING the "chartered surveyor," Mr. Churchill has written: "In a complicated and expanding civilization such as ours, the status and character of the learned or scientific professions become matters of great consequence. . . .

"Here is a scheme of existence which combines variety of experience with a sense of design and of responsibility. Here is a wide scope for initiative and for trained expert opinion. Here is also thoroughness, care and exactitude. Above all there is the strong element of creativeness. Order is emerging from confusion; from a tangle of slums, fine modern, sanitary buildings rise; a marsh is drained and a fertile field bears its crops; an old house from which its owners have been expelled by modern taxation is adapted to new uses and lives again in another form. Public improvements of every kind come into being as the consequence of the surveyor's work. They play an essential part in the ceaseless improvement of our island. They may well feel they are helping to make a better island. Moreover, they see the results of their labour almost immediately. The water flows from the fountain; swift traffic traverses the roads; the hearth-smoke of new homes curls upward in the evening air. Hard work of mind and body, skill of thought, hand and eye, achieve their reward, limited but speedy, utilitarian but definite and concrete. . . .

"In the whole science of town planning, of which, also, we have made only a belated study in our old-fashioned country, the 'chartered surveyor' holds the key position. All the schemes for spreading our cities more widely into the countryside and linking them together at the same time by easy communications, schemes touching intimately and profoundly the health and well-being of millions, can proceed only by his competent and faithful work. His profession, therefore, places him in one of the most active nerve centers alike of the body social and of the body politic.

"Let us then hope that they will fortify themselves for their task by a strong and healthy *esprit de corps* so as to win for themselves an ever-increasing measure of confidence of the public and the honour that comes from doing right things well."—H. S. McComb in "For What Shall We Plan," *The Australian Surveyor*, June 1944.

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I built my house by the side of the road,
The Surveyors came by one day;
Now my house is on top of a hill
And the road is a mile away.

—C.E.H.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

THE ENGINEERING SIGNIFICANCE OF SOIL PATTERNS. Donald J. Belcher, *Proceedings of the Twenty-third Annual Meeting of the Highway Research Board*, November 1943. (Engineering pedology discussed from the standpoint of subgrade problems. A number of extensive soil areas are described in detail and test data showing their uniformity are presented.)

STATUS OF TOPOGRAPHIC AND GEOLOGIC MAPPING IN CALIFORNIA. Olaf P. Jenkins, *California Journal of Mines and Geology*, April 1944.

MODERNIZED MERCATOR MAPS FOR THE AIR AGE (Locher-Hall tele-curve map). *The Griffith Observer*, November 1944. (Describes the tele-curve map which is designed to facilitate the use of the Mercator projection by superimposing curves of great circle distance and curves of various great circle bearings from a chosen point or points on the map.)

NEW USES FOR GLOBES AND SPHERICAL MAPS. Louis H. Powell, *The Geographical Review*, January 1945. (Describes the types of globes and spheres produced by the Science Museum of St. Paul Institute, Minn., for their exhibit "Can America be Bombed?")

TEACHING GEOGRAPHY WITH GLOBES. Thomas Frank Barton, *Education*, January 1945.

EXPANDING THE FIELD FOR THE PRACTICING SURVEYOR. Michael Baker, Jr., *New Jersey Engineer*, January 1945. (Describes how private surveying concerns met the emergency surveying program of the Government and pleads for a fair chance to participate in the Government's postwar program for surveying and mapping.)

A SURVEY OF WORLD ATLASES. Walter W. Ristow, *Library Journal*, January 15, 1945, and February 1, 1945.

A UNIVERSITY LIBRARY REVIEWS ITS MAP COLLECTION: The Cataloger's Point of View. Ottilia C. Anderson, *Library Journal*, February 1, 1945. (Describes map cataloging system at The General Library of the University of California.)

KEY TO A BETTER UNDERSTANDING OF MAPS. II. William H. Gill, *The Military Engineer*, March 1945. (The second in a series of articles on this sub-

ject. Describes the early federal mapping plans and the evolution to the present structure of the federal surveying and mapping agencies.)

THE INVERTING EYEPIECE AND ITS EVOLUTION. E. Wilfred Taylor, *Journal of Scientific Instruments*, March 1945. (Traces the evolution of the inverting eyepiece from a simple convex lens to the elaborate modern systems employing as many as seven component lenses.)

OFFICIAL TOPOGRAPHIC MAPS: A World Index. Raye R. Platt, *The Geographical Review*, April 1945. (Consists of a map of the world on the sinusoidal equal-area projection showing by colors the areas in which published topographic maps on scales up to and including 1 inch = 4 miles have been produced by the official cartographic agencies of the various countries at the outbreak of the present war. The accompanying article describes the scheme, the sources, and the broader significance of the map.)

EFFECTS OF SOIL EROSION ON NAVIGATION IN UPPER CHESAPEAKE BAY. L. C. Gottschalk, *The Geographical Review*, April 1945.

SOME PROBLEMS OF MAP PUBLISHERS RELATED TO WORLD WAR II. D. E. Sites, *The Journal of Geography*, April 1945. (Shows relation of the geography teacher and the map publisher in trying to solve such problems as map projection, amount of detail to be shown, and basis for showing distance on maps.)

CONNECTICUT SECTION PROMOTES ACCURACY OF MAPS. *Civil Engineering*, April 1945. (A resume of the Code of Recommended Practice for Standards of Accuracy of Maps adopted by the Connecticut State Board of Registration for Professional Engineers and Land Surveyors.)

FORESTERS AS TOPOGRAPHIC MAPPERS IN THE REDWOODS. C. K. Lyman, *Journal of Forestry*, April 1945. (This is another account of the project described in "Topographic Mapping in the Redwoods" (see SURVEYING AND MAPPING, October 1944), but with further discussion of the vertical control and traverse methods and costs.)

PRESERVATION AND RESTORATION OF SURVEY MONUMENTS. J. H. Holloway, *The Canadian Surveyor*, April 1945. (Considers four aspects of problem—causes of disappearance, prevention, replacement, and future preservation—with particular reference to the situation existing in the Province of Alberta.)

THE TIDE IN PHILIPPINE WATERS. H. A. Marmer, *U. S. Naval Institute Proceedings*, May 1945.

THEY MAP THE WORLD. Herbert Ringold, *Air Force*, May 1945. (A brief description of the co-ordinated efforts of the aerial photographers and ground "geodet" parties of the AAF.)

AZIMUTH INSTRUMENTS. W. E. May, *The Nautical Magazine*, May 1945. (Describes the various types of azimuth instruments used in navigation at the present time; also includes a brief history of the subject.)

THE UTILITY OF GEODETIC CONTROL SURVEYS. Clement L. Garner, *Journal*

of the Washington Academy of Sciences, May 15, 1945. (Describes the practical uses of geodetic control in civilian and military fields, and discusses the need for international co-operation in mapping.)

MAPPING IN THE SOLOMON ISLANDS. L. E. Nugent, Jr., USNR, *Photogrammetric Engineering*, June 1945. (An account of the photographic missions and mapping activities in the Solomon Islands in 1942 and 1943.)

STEREOSCOPY, ITS HISTORY AND USES. Revere G. Sanders, *Photogrammetric Engineering*, June 1945. (A concise overall picture of stereoscopy and its fundamentals.)

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OSNOVY KARTOVEDENIYA: ISTORICHESKAYA CHAST' (Foundation of Cartography: Historical Part). K. A. Salishchev. *Publishing Office for Geodetic and Cartographic Literature*, Moscow. 1943. 238 pages. In Russian. (Includes a discussion on Russian cartography before the 1917 Revolution and under the Soviet regime. Contains a critical outline on modern cartography outside of Russia.)

OREGON GEOGRAPHIC NAMES. Lewis A. McArthur. *Oregon Historical Society*. 1944. Second edition. 581 pages. $6.00.

PHOTOMICROGRAPHY: An Introduction to Photomicrography with the Microscope. *Eastman Kodak Co.*, Rochester, N. Y. 1944. Fourteenth edition. 174 pages. $2.00. (Surveys the process of photography through a microscope beginning with a description of the necessary apparatus and general optical principles. The special techniques for motion photomicrography and color photomicrography are explained, and a selected bibliography is appended.)

THE EARLY CARTOGRAPHY OF THE PACIFIC. Lawrence C. Wroth. *Papers, Bibliographical Society of America*, Vol. 38, No. 2. 1944. Pages 85–268; maps, bibliography of maps. (A monograph which traces and illustrates the process by which the coast lines of the Pacific and Indian Ocean areas became apparent from early voyages and discoveries.)

MAP READING. Elaine Forsyth. *McKnight and McKnight*, Bloomington, Illinois. 1944. 64 pages. $0.60. (Covers the fundamental concepts of map reading for junior–senior high school levels.)

CERTIFICATED AIRLINE MAP OF THE WORLD. Floyd A. Stilgenbauer and Spencer A. Larson. *Wayne University Press*, Detroit, Mich. $1.25. (Based on a new projection—the Polar Lobate Globoid. The corners of the sheet are utilized to give many airline distances.)

ELEMENTARY SURVEYING. Charles B. Breed and George L. Hosmer. *John Wiley & Sons*. Eighth edition. 717 pages. $4.00.

PHOTOGRAPHIC SURVEYING. B. B. Talley and Paul H. Robbins. *Pittman Publishing Co.*, New York. 1945. 232 pages. $3.00. (A textbook on aerial and terrestrial photogrammetry, illustrated by numerous diagrams and photographs.

A detailed study of the science of photography and its use, through interpretation, and its limitations for mapmaking.)

BOOKS RECEIVED

THE STATE COORDINATE SYSTEMS (U. S. Coast and Geodetic Survey). Hugh C. Mitchell and Lansing G. Simmons. *U. S. Government Printing Office*, Washington, D. C. 1945. 62 pages. $0.25. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

BOUNDARY-MAKING: A Handbook for Statesmen, Treaty Editors and Boundary Commissioners. Stephen B. Jones. *Columbia University Press.* 1945. 268 pages. $3.00. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

MAGNETISM OF THE EARTH (U. S. Coast and Geodetic Survey). Albert K. Ludy and H. Herbert Howe. *U. S. Government Printing Office*, Washington D. C. 1945. 77 pages. $0.35. (To be reviewed in a later issue of SURVEYING AND MAPPING).

DISTINCTIVE RECENT MAPS

The most important and elaborate original map to which we call attention in this issue is the "Tectonic Map of the United States," 1: 2,500,000, published by the American Association of Petroleum Geologists and prepared under the direction of a committee of the National Research Council. Geologic structure, as evidenced and interpreted by a combination of outcropping areas, bedrock, surface disturbance, and subsurface deformation, is indicated by colors, symbols, contours, and descriptive explanation. Igneous, metamorphic, and selected areas of sedimentary rock are mapped. Salt domes, crypto-volcanic disturbances, and submarine contours are shown. The base map shows state boundaries, rivers, a pattern of cities, and 1-degree lines of latitude and longitude. The map, which is printed in seven colors, on two sheets, is described in detail in the Bulletin of the American Association of Petroleum Geologists, December 1944.

The American Ethnological Society has recently published a "Map of North American Indian Languages" compiled and drawn by C. F. Voegelin and E. W. Voegelin, scale 150 miles to the inch, covering North America north of Mexico. Six major linguistic groups are shown by flat colors. The boundaries of the areas in which nearly 200 different languages are now, or were formerly, spoken are indicated by broken lines and the languages are identified by numbers, for which a key is provided on the map. It is of interest to note that the greater part of the Ohio valley is left blank, since this area was "uninhabited in early historical periods."

In the April 1945 issue of SURVEYING AND MAPPING we called attention to the maps currently issued by the Office of Strategic Services. Among those classified as "free" are certain colored maps on different scales that would be of value to anyone teaching the geography of Germany. These show, among other things, administrative areas, selected railroads in relation to terrain, inland waterways, surface configuration, and land utilization (differentiating arable land, woodland, grassland, heath, moors, and wastelands). An unusually interesting map, based on a project of library research undertaken by the Office of Strategic Services, shows the caves and cave regions of

"Greater" Germany. At the time when this map was being prepared, in the winter of 1944–1945, it was believed the caves might be of considerable military importance in the defense of the mythical German "National Redoubt." For Far Eastern areas brief reference may be made to the three colored maps of Borneo on the scale of approximately 80 miles to the inch, showing, respectively, administrative divisions, Indonesian peoples and Christian missions, and the distribution of population—the last with insets for Chinese and European populations.

The American Geographical Society is beginning to receive maps and other publications from France after a 5-year lapse. Among them is a set of 90 uncolored maps issued by the Syndicat des Entrepreneurs de Réseaux et de Centrales Electriques, Paris, and dating from the late prewar and early war years. These show the electric transmission lines for each department of France. Of broader interest, however, is the new edition of the *Atlas Universel de Géographie* of Schrader, published by Hachette (undated, but probably 1943). Although this does not differ essentially from the 1923 edition, it may well occasion surprise and admiration that a work so splendidly executed on paper of such high grade could appear in France during the occupation. The Society has also received the first part of the last tome to appear in the great series, *Géographie Universelle*, Tome VI, La France, Part I, France Physique, by Professor Emmanuel de Martonne (Armand Colin, 1942). Like its predecessors, this work contains an abundance of truly exquisite maps and diagrams in black and white and also a beautiful and highly ingenious colored "Carte Morphologique de la France et des Régions Voisines" (1: 2,500,000).

JOHN K. WRIGHT

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Mercator—Ace of Map Makers

ALTHOUGH entirely wrong because it is impossible to show a curved surface upon a flat surface accurately, Mercator's projection is the most popular in the whole world for maps. While Mercator died 350 years ago, his projection has never been really improved upon for maps! Only today, in this age of great sea travel and air transport can we fully appreciate the value of the projection developed by the map maker of centuries ago. Whilst the projection may give an entirely wrong impression of the world, both naval men and pilots find the maps accurate because in spite of its other drawbacks the Mercator projection gives the true compass bearing between any two places in the world.

In Mercator's day the world was to map makers a much smaller place than it is today. The great Elizabethan voyages of exploration were just taking place and few men had any idea how big the world really was. Map making has two essentials. They were true essentials of the Ancients, for it must be remembered that even the Babylonians, long before the Age of Ancient Rome, had their maps. One thing a map must do is mark a place on the earth's surface so that with the aid of the map anyone can find it. In order to do this accurately the map maker must

have some knowledge of the size and shape of the earth. These two conditions still hold good today, and although we like to think accurate maps a recent innovation it was the ancients who discovered the principles upon which map making is based. It was the Babylonians who worked out the system of dividing the heavens into a girdle of 360 degrees and dividing these in turn into the 60 minutes and the minutes into 60 seconds—all of which we use today. It was a Greek librarian who realized that the world was round and worked out an approximate figure for its size—and this figure many centuries afterwards was proved almost correct.

Mercator was the greatest map maker right up to modern times. Before his day there were many maps of the world. Some had a little claim to accuracy and others were just wild guesses at place and size of countries. Their relationship of the land masses wasn't even accurate and on many parts of these maps were outlines showing unexplored country. Mercator tackled the tremendous task of giving the world some idea what the earth really looked like. He was stumped right away, as other men had been before him and indeed as men have been right up till the present day by the difficulty of having to reproduce a curved surface on a flat sheet of paper.

This great map maker took pains with his work. He calculated carefully and left as little as possible to chance. He actually prepared an accurate map of Britain drawn on a scale of *one inch to fourteen miles!* When this map was discovered recently in a museum and carefully photographed, cartographers were surprised to find how accurate it really was. This map of Britain was drawn before the great map maker tackled the even greater job of producing a fairly accurate map of the world. Mercator produced his chart and it proved to be easily the best of its kind. Experts are agreed that all modern geography and map making really began with Mercator—the ace of map makers who died on 2nd December 1594.—*The Nautical Magazine* (London), March 1945.

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Soviets Map Kamchatka

Two Soviet military expeditions have completed a mapping survey of 200,000 square kilometers of the mountain regions in Kamchatka Peninsula, strategic area which juts into the northern seas just above the Japanese Kurile Islands, the army newspaper *Red Star* discloses.

The expeditions were led by lieutenant colonels who left for Kamchatka in 1942 and spent some 540 days on their explorations. A detailed study was made of weather conditions as well as careful maps of the mountain regions.

Kamchatka lies between the sea of Okhotsk on the west and the Bering Sea on the east. It is about 450 miles west of the U. S. base Attu Island at the western tip of the Aleutians.—*PM*, May 28, 1945.

Book Review

MANUAL OF PHOTOGRAMMETRY. American Society of Photogrammetry. *Pitman Publishing Corporation.* New York. 1944. IX and 841 pages. $8.50.

Reviewed by Commander K. T. Adams, Chief, Topography Section,
U. S. Coast & Geodetic Survey, Washington, D. C.

THE USE of aerial photographs in map making, in intelligence studies, and for other purposes has expanded at an unprecedented rate during the last decade. Today no one thinks of making a map without using aerial photographs. The appearance of the manual at this time is a welcome addition to the current literature on the subject.

Of the many texts dealing with aerial photography and photogrammetry that have been published in recent years, this manual ranks nearest to being a complete modern text and reference book on the subject. The preparation of the manual was sponsored by the American Society of Photogrammetry and a leading authority was selected to author each field of the science. There are 17 chapters in all, each chapter dealing with a separate phase of the subject. Among these are: Photogrammetric Optics, Cameras, Photographic Materials and Laboratory Technique, Stereoscopy, Photographic Mosaics, Stereoscopic Mapping Methods, Analytical Computations, Mapping from Oblique Photographs, Training and Education, and Nomenclature and Definitions. The text is illustrated with numerous well-chosen line drawings and photographs.

It is impracticable in this short review to discuss individually the various subjects and the wealth of information which comprise the manual. While the meticulous reader may sense in the manual a lack of continuity and uniformity, as well as a few glaring omissions, it should be noted that the Society recognizes these and intends to remedy them in a revised edition to be published after the war. In partial explanation of these deficiencies, it should be said that the chapters were written at different times and many of them appeared from time to time in "Photogrammetric Engineering." These plates were preserved and used in printing the present volume.

One omission to which attention should be called is the practically complete lack of text concerning field surveys. The misconception is widespread that aerial photography has moved map making from the field to the office, but this is only true for small-scale reconnaissance mapping. For large-scale mapping complying with the "National Standard Map Accuracy Requirements" approximately half the total cost of a map is still expended in ground surveys. In using aerial photographs in map making, there are technical requirements connected with the required ground surveys with which the field surveyor is ordinarily not acquainted.

Certain well-known stereoscopic plotting instruments, such as the aerocartograph, stereoplanigraph, and the K.E.K. plotter, are either ignored completely or only mentioned incidentally, and the section on the Multiplex is incomplete. This is no doubt the most serious deficiency in the manual. The K.E.K. plotter

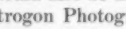
is a comparatively new instrument and for that reason may not have been included. The wide use of the Multiplex and its flexibility as a stereoscopic mapping instrument certainly warrant a thorough technical explanation of the theory and operation, with instructions for its use. Most of the text about the Multiplex deals with an explanation of the instrument and its accessories.

The reader is also confronted with the fact that each author has used a different set of algebraic symbols and a different terminology, even though a detailed set of approved definitions is included in the book.

Two chapters need to be specifically mentioned—those on "Training and Education" and "Nomenclature and Definitions." Numerous institutions are starting or considering courses in photogrammetry and these chapters should be of much value. The science of photogrammetry is comparatively new, it is suffering with growing pains, and one of these pains is its heterogeneous terminology. Now, before it is too late, is the time for the adoption of a standard nomenclature.

Special mention perhaps should also be made of the section entitled "Reconnaissance Mapping with Trimetrogon Photography," since this is not a chapter heading and has become so important during the war in small-scale mapping of large areas. The section has its own index and it is perhaps treated more comprehensively and with more continuity than some of the other subjects.

The manual is a noteworthy attempt to meet an obvious and definite need for accurate, technical data useful in the practice of aerial photography and photogrammetry. The American Society of Photogrammetry is to be congratulated in successfully bringing out such a manual in the midst of all the difficulties encountered during wartime.



New Map of China

ANOTHER timely addition to the National Geographic Society's war-time series of maps is the new map of China, which supplements the June 1945 issue of the National Geographic Magazine.

This map shows today's alignment of China which is composed of 28 provinces, the territories of Outer Mongolia, Tannu Tuva, and Tibet. Some other interesting and timely data included are: the detailed coverage of roads, showing virtually all highways which might be used for military purposes; the famous aerial "Hump" route over the Himalayas from India to Chungking; and the east China coast and how the approaches are guarded by the southern end of the Japanese islands, the Ryukyu Archipelago, and Formosa.

In addition to the portrayal of China proper, the map coverage includes the Pacific area to the east of the China coast, extending from Lingayen Gulf, in the Philippines, through the Japanese home islands, and extending eastward to the island group which includes Iwo Jima. Parts of Southern Siberia, India, Burma, Thailand, and French Indo China are also shown.

This new map is constructed on the Albers Conical Equal-area Projection, at a scale of 1: 7,000,000. It is printed in 10 colors, on a sheet 37 by 26½ inches.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR.

RANDOM THOUGHTS FROM A LAND SURVEYOR

KENNETH E. MCINTYRE.*—I read with interest Professor Rayner's article on "Education in Surveying and Mapping After the War," which appeared in the October 1944 issue of SURVEYING AND MAPPING. I do not wish to criticize the article in general, but I do want to point out that his statement, "Massachusetts, with its excellent system of control and its land court, with all surveys under competent supervision, is our shining example of how land surveying should be done," may give surveyors in other states the impression that we in Massachusetts are engaged in surveying in some kind of Utopia. Actually, the surveyors in the country districts of Massachusetts are up against some of the most difficult problems of replacing old boundary lines in the United States. The reason for this is very apparent after a brief study of the history of Massachusetts.

Massachusetts was one of the Thirteen Original States, and, around 1630, had a population of from ten to fifteen thousand. All lands in that period were granted by the King through the Colonial Legislature, and very little attempt was made to lay out land by the rectangular system. Consequently, all tracts of land were irregular. Not many surveys were made, but those that did exist were made by compass and chain. It is true that we have a system of triangulation and geodetic traverse for control, and in some counties we have outlying roads laid out mathematically with bounds set. This is done by the State Department of Public Works, and by counties having engineering departments. But most of the smaller towns do not have engineering departments; they rely on the local surveyor or engineer, or on none at all.

In 1898 the State established a Land Court, separate from all other state courts, and designed to clear titles and fix boundary lines. The Land Court has been a great help towards improving surveying in Massachusetts, but unfortunately only a small part of the surveys in the Commonwealth are registered in this Court. These are partly supervised by the Court's Engineering Department, which publishes a book of general

* Registered Land Surveyor, Walpole, Massachusetts.

instructions for Land Court surveys. These instructions cover the mathematical accuracy required and general drafting, but do not instruct the surveyor on how to make an individual survey. One may go, however, to the Engineering Department where information and advice are freely given. The surveyor appreciates the Land Court because through this process the boundaries are established, and both the worry and the responsibility attached to the surveys filed in the County Registry of Deeds are partly eliminated. Surveyors are often called upon to make court surveys—not necessarily pertaining to land-line disputes—and to give testimony in court. This work taxes the surveyor's ability to the utmost, and his knowledge and experience can and should be very important. He should be so well trained that he may present facts and figures to the court so as to assist the judge or jury in arriving at a decision.

A surveyor can be of great help to a growing community, or he may be a hindrance to its healthy growth, he being the first person called in when there is thought of a land development. In most cases the land owner knows very little about such matters as zoning laws, building laws, and board-of-survey laws, or how to design streets, parks, or playgrounds. The surveyor may help the land owner or developer to have something attractive to sell to the public, as well as to improve the town or city as a whole. The surveyor's knowledge of the contour of the land and the land titles in his locality gives him the advantage of determining with the minimum of work what this development will cost.

Need for Organization

I have discussed the possibility of organizing surveyors in this vicinity into a section of the American Congress on Surveying and Mapping, and of affiliating with the Boston Society of Civil Engineers. It becomes apparent that, by an organization of practicing land surveyors, a great deal could be accomplished for the general public, the law profession, and for land surveying itself.

There are many subjects that land surveyors should be familiar with, among which may be mentioned the following:

Boundary control—both legal and mathematical
Importance of conflicting elements in different surveys
Excess and Deficiency
Adverse possession
Dedication
Law and Ordinance
Astronomy and Geodesy
Ethics
City planning

Some of these may seem foreign to the construction engineer, but to the land surveyor they are most important. In the schools and colleges there are no adequate courses dealing with these subjects, and the engineer graduate of today is sorely lacking in these fundamentals. I believe that through an organization of surveyors the teaching of such subjects could be stimulated.

After the war, most of our cities and small communities will need extensive building and rebuilding—vast housing projects, storm-water and drainage systems, and more parks and playgrounds. Hundreds and maybe thousands of airports will be required and our highways will need modernizing. All of these will demand the services of the practicing surveyor and engineer. There is no question but that now is the time for surveyors throughout the country to organize into local societies—within the framework of the American Congress on Surveying and Mapping—to study postwar problems.

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NOMENCLATURE OF MAP PROJECTIONS

May I also support Sir Gerald Lenox-Conyngham's suggestion to give up the word *conformal?*

We are justified in substituting a "c" for the "k" in such German words as *Koordinate* and *kolossal,* because we probably had them first or at any rate can claim an equal right. But *konforme,* in this sense, like many of the elephantine ideas associated with the subject, has a pure neo-Aryan flavor and on this ground alone is all to the bad.

British geodesists have, or should have, sufficient native background to stand squarely on their own legs without too much regard for German copy-books. We shall also make the subject more intelligible if we use one word to express one idea. *Conformal* alone will not serve our purpose, whereas *orthomorphic* does. For instance *conformal conic* or *conical conformal* would suggest a music hall turn rather than a map projection.

But it is when we try to form a noun corresponding to *orthomorphism* from *conformal* (and incidentally even the Germans do not talk about *Konformigkeit* in this sense) that we are up against stark crudity. "The necessary and sufficient conditions for *conformality*" would sound like an article on etiquette for "stuffed shirts"; while *conformalism* or *conformism* conveys a sense of religious revival sooner than any obvious clue to the subject at issue.

It seems unlikely that we can ever wean the pure mathematical followers of Gauss from the use of the term *conformal representation* in their more general treatment of the subject. I suggest, however, that it is all to the good to have a separate term applicable to the narrower application of map projection from the particular surface of a spheroid of revolution.—M. Hotine in "Letter to the Editor," *Empire Survey Review,* January 1945.

CONGRESS NEWS

Reports of Technical Divisions

(Presented at Annual Meeting—June 23, 1945)

PROPERTY SURVEYS DIVISION

THE following is the first annual report of the Property Surveys Division of the American Congress on Surveying and Mapping:

The first activity of the Division was the appointment of officers and committee chairmen. (A list of these was published in the January issue of SURVEYING AND MAPPING.) Certain methods of procedure have been set up within the Division.

To this Division was referred the matter of the so-called "G.I. Bill of Rights," insofar as it affects the surveying of properties. Your chairman appointed a committee consisting of W. N. Brown, Chairman, Regional Vice President W. L. Prouty, Division Vice Chairman E. H. Owens, to study and act on the matter within certain limits. We cannot as yet report the results of this committee's action.

Some investigation was made in the direction of increasing the membership in the Congress, by two of the Division officers. The investigation proves that there is a large field to work on, and new members can be enrolled with a minimum of effort. (Some sixteen new members responded readily to the efforts of the two officers.)

The principal activity of the Division—being the principal activity for which the Division was formed—was in the direction of the development of Standards of Practice for property surveys. Vice Chairman Owens propounded the general question. Copies of his analysis of the problem were distributed to all the Division officers and chairmen, with the request that they express their opinions and recommendations on the various phases of the problem and submit them to Technical Standards Chairman Wattles. Mr. Wattles' duty was that of compiling and co-ordinating the data submitted to him by the officers and chairmen in a summary and recommendation for a Standard of Practice. Mr. Wattles has recently completed his summary and report. It is your chairman's opinion that Mr. Wattles' report represents the most forward step yet taken in this direction, and is a document of which the Division can be proud.

It is planned that the next step will be the distribution of Mr. Wattles'

report to the 1945–46 officers and committee chairmen of the Division for discussion and such revision as is agreed upon by the Division officers and chairmen, acting as an Executive Committee for the Property Surveys Division.

Because of the importance of the matter, it is suggested that the report, at that point, be published in SURVEYING AND MAPPING, in order to give the members of the Division the opportunity to express themselves. After a stated period of time, such opinions as develop from the membership would be reviewed by the Executive Committee, so called, who would agree on a final form for the Standards of Practice.

In that final form, the Standards of Practice would be submitted to the Congress with a recommendation for adoption, and the development of proper publicity for the dissemination of the Standards. (The report contains certain recommendations as to procedure on this point.)

Your chairman wishes to express his thanks to the various men who have worked with him during the past year in the Property Surveys Division, with particular recognition to Mr. Wattles for the remarkable job he has performed on the report, to Mr. Hanson for his energetic work as associate editor of the Division, and to Mr. Owens for his valued experience in the problems of the surveyor.

Your chairman further wishes to express his pleasure in having been associated with the officers of the Congress for the past year. It is your chairman's opinion that the Congress offers the surveyors of this country a fine opportunity to overcome the many inequities and iniquities of the profession, and that, with a planned membership drive, we should have no difficulty in increasing our membership two or three fold.

S. A. BAUER, *Chairman.*

TOPOGRAPHIC MAPPING DIVISION

THE Division of Topographic Mapping was inactive during the past year. With so many members of the Congress most concerned with topographic mapping immersed in war projects, and largely because of limited time available and, to some extent, due to the confidential nature of their work, little progress has been made in arranging for the detailed discussions of projects and accomplishments.

It is expected that during the ensuing year, and those immediately following, quite a number of articles on various phases of topographic mapping will be published in SURVEYING AND MAPPING dealing largely with new developments in techniques that have become more or less established and proved through use. Accordingly, much greater activity in technical discussions is expected at future meetings than has been possible during the past 3 years.

The mapping programs developed and sponsored by agencies in many of the states augur well for postwar mapping projects in the United States. America's inevitable role in world affairs indicates that present foreign projects may be continued to an economical conclusion. Much interest is evidenced in comprehensive programs for mapping foreign territories and our island possessions. Furthermore, owing to the vast coverage of foreign areas by aerial photography by the Army Air Forces, it is very likely that foreign countries not previously map conscious, will desire general coverage maps for general planning and economic development.

Mapping by stereophotogrammetric and ground methods are now so closely intertwined that it is often difficult to draw an absolute distinction between the two methods. More often the two methods are combined in producing a finished product. As they are so closely allied in our present-day topographic mapping procedures, there appears to be overlapping interest on the part of the membership of two technical divisions of the Congress. I refer to the Division on Photogrammetric Mapping and the Division on Topographic Mapping. For some time it has been my belief that because of such overlapping of interest these two technical divisions should be merged.

I therefore recommend such action for the consideration of the Executive Committee of the Congress at this session. Perhaps a "Division on Photogrammetric and Topographic Mapping" would be an appropriate designation for the merger.

JOHN G. STAACK, *Chairman*

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Eight More States Adopt Plane-Coordinates

SINCE the first of the year eight more states have formally adopted the plane-coordinate systems devised by the U. S. Coast and Geodetic Survey for transforming geodetic position data for use in plane-surveying operations. The eight new states to take this action are: Georgia, Delaware, Rhode Island, Minnesota, Oregon, Washington, Nevada, and Vermont.

Before January 1 of this year nine other states had already adopted the system. These states are: New Jersey, Pennsylvania, New York, North Carolina, Maryland, Massachusetts, Mississippi, Texas, and Louisiana.—*Engineering News-Record*, July 19, 1945.

Secretary's Report

(As Presented at Annual Meeting—June 23, 1945)

THE growth in the business of the Congress has been indicated by a steadily increasing volume of mail. The Secretary has been aided in disposing of this correspondence by the able and willing President at Chattanooga, by the Editor, and by the Vice President of Region 2, retaining for himself little more than the necessary recording. Notices of changes of addresses of members and inquiries from prospective members, which have been numerous, have maintained a steady flow of correspondence. Much interest has been stirred by the Property Surveys Division under the chairmanship of Mr. S. A. Bauer, and by the W. N. Brown Inc. prize competition for the best articles on "The Use of Plane Coordinates in Property Surveys."

Wartime duties and restrictions on travel kept the Executive Committee meetings, in Washington, down to three. One special meeting took place at which several of the officers of the Congress were guests at luncheon of Mr. Herbert M. Dibert, Chairman of the Technical Division on Surveying and Photogrammetric Instruments. At this meeting the relationship of the Congress to the S.P.E.E. was discussed, as well as the matter of how the Congress can best reach the "grass roots" surveyor. Mr. Dibert's untimely death a week later was a shock and a grievous loss to the Congress.

Two other meetings of interest to the Congress were held during the year. One was the meeting of the American Society of Photogrammetry on October 19, 1944, in the auditorium of the Interior Department, to which the membership of the Congress was invited. The feature of the meeting was Mr. Robert H. Randall's illustrated account of the trip of the United States delegates to the Second Pan American Consultation on Geography and Cartography held at Rio de Janeiro, Brazil, in August.

The other was the meeting held on June 21, 1945, in the auditorium of the Department of Agriculture, under the auspices of Region 2 of the Congress for the purpose of discussing topographic mapping needs by mapping representatives of the six states in the Region, and by officials of the federal bureaus. (A detailed account of this meeting appears elsewhere in this issue.)

The second color film, "Geodetic Surveying," in the series produced under the direction of the Committee on Cartography of the Pan American Institute of Geography and History in co-operation with governmental agencies was made available to the Regions of the Congress. This film shows the various operations in developing geodetic control from original reconnaissance surveys to the final office computations.

The continued improvement of our Journal deserves special mention. Its excellence is due to Editor A. L. Shalowitz' ability and energy and the aid given him by the Publications Committee.

As a means of enhancing good will and understanding among the members of the surveying and mapping profession in the American Hemisphere, the Congress has undertaken the preparation of a Spanish edition of the January 1945 issue of SURVEYING AND MAPPING to be sent to the South American republics. The cost of translating and printing the edition is being underwritten by five commercial firms. This project is still underway.

A committee, under the chairmanship of Mr. Walter S. Dix, has been appointed to study the feasibility of the Congress sponsoring the preparation of a sound film on mapping processes and map uses; such film to be distributed and shown at motion picture houses throughout the country.

Since the last annual report the Congress has added to its roster of members 2 Commercial Members, 7 Library Members, and 142 Individual Members. It is hoped that this rate of increase will be accelerated when the special committee, appointed to conduct a membership drive, gets underway. Of the older members about one-fourth have not yet remitted their dues for 1945, and if they would do so now the Secretary would be relieved of the bother of mailing out second notices.

Respectfully submitted,

RICHARD T. EVANS,
Acting Executive Secretary.

FINANCIAL STATEMENT

(As of June 30, 1945)

Balance on hand (July 1, 1944)		$ 646.65
Receipts		
Memberships (Commercial)	$ 350.00	
" (Libraries)	35.25	
" (Individual)	1,933.58	
Reimbursements	8.25	
For Spanish edition (from two firms)	200.00	2,327.08
Total to be accounted for		$3,173.73

Expenditures

Printing	$1,260.38	
Mailing service	221.20	
Second class mailing privileges	35.00	
Office supplies	186.75	
Stenographic service	82.18	
Banking service	22.36	
Post office box rent	12.00	
Total expeditures		$1,819.87
Balance on hand (June 30, 1945)		$1,353.86
Unpaid obligations:		
Spanish issue	$ 200.00	
April issue SURVEYING AND MAPPING	339.03	539.03
Net worth of Congress		$ 814.83

Respectfully submitted,

RICHARD T. EVANS,
Treasurer.

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In Memoriam

GEORGE WELLINGTON PICKELS, Professor of Civil Engineering at the University of Illinois since 1931, died on December 2, 1944. Born in Richmond, Kentueky, on September 5, 1883, he early pursued an engineering career and in 1911 accepted an instructorship in the University of Illinois which would permit him to combine teaching, research, and writing. His investigations of the drainage and flood control problems of the State, often in collaboration with the Illinois State Geological Survey, and the publication of a number of reports and bulletins established him as a leading authority on the two subjects. His knowledge of the hydrological characteristics of the basin of the Big Muddy River contributed to the construction of the Crab Orchard Dam near Carbondale, and he contributed much data to an elaborate report on the valley of the Kaskaskia River, issued in 1937 and now being used in preparing postwar plans for the development of that region. He found time to serve on many committees of engineering societies and to participate in the civic affairs of Urbana by serving as alderman for 4 years. He is survived by Mrs. Pickels, a son, and a daughter.

—R. T. E.

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